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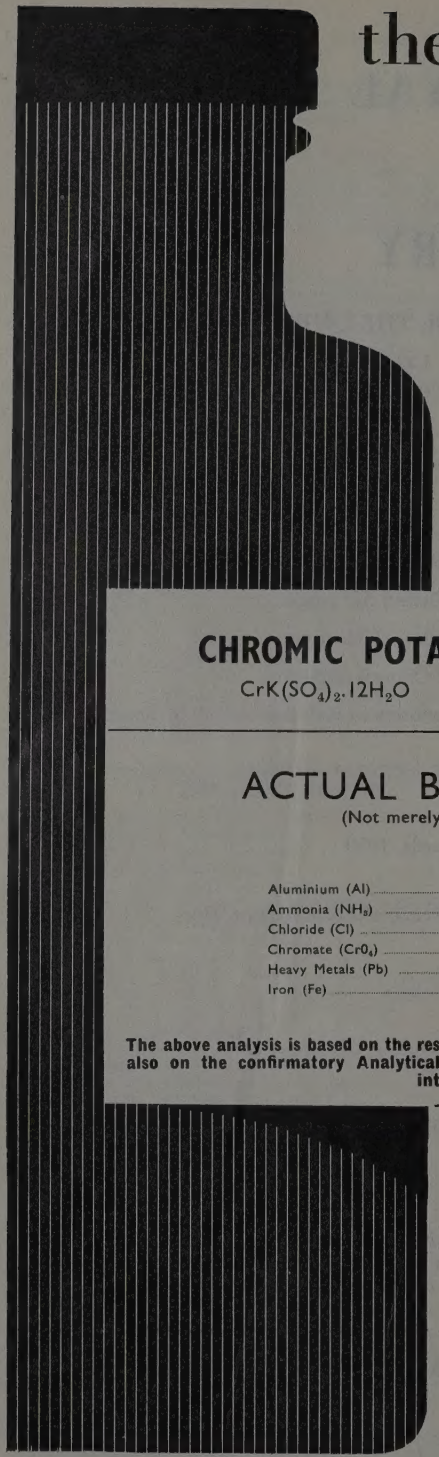

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SCIENCE AND INDUSTRY IN PAKISTAN

One of the first steps taken by the Government of Pakistan after partition was to establish a Department of Scientific and Industrial Research under the Ministry of Industries. Implicit in this decision was the recognition of the importance of scientific and industrial research in the economic development and well-being of a nation. The Department was charged with drawing up the constitution of a Council of Scientific and Industrial Research that would best serve the interests of the country. In April 1953 the Council was established as an autonomous body. The first published Report of the Council* sets out in detail its constitution and objects and reviews developments and achievements during the first five years of its existence. The full extent of those achievements will be apparent only to those familiar with the formidable problems and difficulties that confronted Pakistan after partition. A first-hand account of the early scientific work of the Council was given in this *Journal* (1957, 417) by the late Dr Bashir Ahmad whose sudden death deprived Pakistan of one of its leading scientists and a dedicated servant. He concluded his review on rather an apologetic note. 'Three years is a very short time for a research organization, still struggling to establish itself, to show any considerable achievement in a new country faced with many difficulties.' The achievements he reported were not inconsiderable. Viewed against the background of the many difficulties they were indeed impressive. This quinquennial Report outlines further notable developments, despite continuing difficulties.

The West and East Wings of Pakistan are separated by over 1000 miles of land, even many more miles of ocean. Its natural resources and major industries are widely dispersed. These considerations led the Council to adopt a pattern of Regional Laboratories, covering a wide range of scientific interests of special relevance to the areas concerned, rather than a series of national establishments devoted to the separate sciences and technologies. Experience has clearly confirmed the wisdom of that choice. The Council inherited no ready-made laboratories. The Central Laboratory in Karachi and the three Regional Laboratories in Lahore, Peshawar and Dacca (East Pakistan) had to be planned, erected, equipped and staffed. Recruitment proved to be the most serious obstacle. The Report speaks of a 'chronic shortage' of scientifically trained personnel.

The primary function of the Council is to promote scientific research aimed at the industrial development of the country and the efficient utilization of its natural resources. At the same time, it is the declared policy of the Council to foster and encourage fundamental research—'to guard against the drying up of the sources of knowledge.' Dr Bashir Ahmad's earlier account deals with progress on most of the applied research projects during the period under review. Nowhere in the present Report is the emphasis on fundamental research more clearly brought out than in the section dealing with investigations on indigenous medicinal plants, in particular, chemical and pharmacological studies on the alkaloids of *Rauwolfia Serpentina, Benth.* Here we see the dominating influence of the Council's Director, Dr Salimuzzaman Siddiqui, an eminent authority in this field. The Council's research activities have not developed uniformly in all directions.

The Council maintains close liaison with the universities and other research establishments and its Research Committees scrutinize schemes for specific extra-mural research work and make recommendations regarding grants in aid. In its concern to translate the results of research into commercial practice the Council has set up a Research Utilization Committee pending the institution of a specialized agency in the form of a Research Development Corporation. Scientific and industrial liaison is also maintained on both a national and international level. An additional responsibility of the Council is the collection and dissemination of scientific and technical information. With the assistance of UNESCO, a National Scientific and Technical Documents Centre has been established in Karachi. This, surely, constitutes a major contribution by the Council to the advancement of science and technology in Pakistan. Since 1958, the Council has published its own scientific Journal (see *J.*, 1958, 282).

Grateful acknowledgement is made in the Report of international assistance, under the Colombo Plan, from UNESCO and FAO, in the furtherance of the Council's work. This aid has taken the form of financial assistance for the procurement of scientific and technological equipment, the advisory services of experts of international repute and the provision of training facilities for Pakistani students in foreign countries. The U.K. Government made a grant of Rupees 10 lakhs towards equipping the Central Laboratory at Karachi.

Difficulties remain to be overcome; not least is that of scientific manpower. Realizing that the pace of progress must depend on the progressive availability of scientifically trained personnel, the Council is striving unremittingly to promote its training schemes.

The Council deserves congratulation on the impact that it has already made. It has gone a long way towards establishing itself as a national asset, and this is only a beginning.

J. Idris Jones†

* Pakistan Council of Scientific and Industrial Research. Quinquennial Report 1953-1958. Karachi, 1959.

† Dr Idris Jones visited Pakistan in 1951-1952 as a member of an advisory mission, under the Colombo Plan, sponsored by the U.K. Commonwealth Relations Office—Ed.

THE CHEMICAL SOCIETY AND THE INSTITUTE

JOINT ANNUAL MEETINGS—BELFAST, 5-8 APRIL

In retrospect, the happy and successful meetings at Belfast will have various associated memories for more than 600 people who took part and many others who provided for their enjoyment and entertainment. For some these memories will include the first aerial glimpse of Liverpool or The Calf of Man some three miles or more below through breaks in the clouds. Others will recall their unexpected arrival via Dublin, as weather conditions made it impossible for them to land at their scheduled airfield. A later group found their flight cancelled, and they arrived the following day. Many came punctually by more traditional modes of transport, and were intrigued, but not misled, by a sign inscribed 'Bypass to the City Centre.' To some there was the surprise to find that Chlorine Gardens actually does exist and the discovery that 'bally' has a geographical significance. For all who live on the island the meetings provided yet further gratifying evidence that, whatever factors tend to divide peoples among themselves, a common interest in the world of science is a great unifying force.

The City's gesture in providing journeys free on Corporation buses throughout the period of the meetings was a great boon and was highly appreciated by all those who arrived without private transport. One conductor, enjoying his delegated role as host, said that he met 'another lot of nice people' some time back, but they were not chemists—they were scientists. Apart from this lapse, however, public relations were good. This was due partly to the efforts of Dr R. J. Magee, who, as secretary of the local organizing committee, had filled almost a page of the *Belfast Telegraph* on Friday, 1 April (not a significant date in Ulster, we understand), with an explanation of what chemistry has come to mean there, and an account of the two chemical bodies and their forthcoming programmes.

The majority of the visitors stayed in hotels but two university hostels—Riddel Hall and Queen's Elms—accommodated about 100 members and their guests. Lunches were provided each day at Queen's Elms. The thanks of all who took advantage of these amenities are extended to the Wardens for sparing no effort in securing their comfort. Light meals were also available in the David Keir Building. Here, in the reception lounge, the Society and the Institute were able to display some of their recent publications.

The business meetings were also conducted in the finely designed and equipped David Keir Building, with the exception of the Society's Meeting of Local Representatives and the Institute's Conference of Hon. Secretaries, which were held in the dignified and graciously appointed Senate Room in the Main Building. We are most grateful to the University authorities for making available such ideally suitable facilities.

TUESDAY, 5 APRIL

The programme began on Tuesday, 5 April, with a lecture by Professor A. Butenandt on the biogenesis and physiological importance of the relatively recently discovered group of natural pigments known as ommochromes. This lecture, both topical and of absorbing interest, gave an account of work done almost up to the moment when the lecturer left the Max Planck Institut, Münich, for Belfast. Sir Alexander Todd, F.R.S., President-elect of the Chemical Society, took the chair. In the afternoon there were two further lectures, the chairmen being Professor R. A. Raphael and Professor H. B. Henbest, the former and present occupants of the Chair of Organic Chemistry at Queen's University. Both were formerly students under Professor E. R. H. Jones, F.R.S., of Oxford, who gave the first lecture on acetylene–allene chemistry. This was followed with an exposition of the function of ion-pairs in solvolysis and exchange by Professor S. Winstein of the University of California.

For those not attending the lectures there were afternoon visits to Short Brothers and Harland Ltd (aircraft construction), United Chrometanners Ltd (leather for ladies' shoes and light goods) and the Belfast Ropeworks Co. Ltd, and a tour of Belfast and its suburbs (repeated on subsequent days).

In the evening members and guests received a warm welcome in the City Hall, at a Civic Reception and Dance held by invitation of the Lord Mayor and Corporation of the City of Belfast. Guests were received by the Lord Mayor, Alderman Robin G. C. Kinahan, E.R.D., J.P., and the Lady Mayoress, together with the two Presidents and their ladies. Apart from the enjoyable dancing, the occasion provided a good opportunity for the renewal of old acquaintances and the making of new ones.

WEDNESDAY, 6 APRIL

On Wednesday morning the Institute's Annual General Meeting was held (*see* p. 167) in the David Keir Building, while a meeting of Local Representatives of the Chemical Society took place in the Senate Room. Mr Herbert, in his Presidential Address (*J.*, 126), took advantage of all the excellent facilities available in the Lecture Theatre, illustrating his talk with numerous slides, a film sequence and a specially edited version of a film showing the building of the refinery at Stanlow (see *J.*, 132). Those who knew how much care and thought had gone into the preparation of

the address were not surprised at its enthusiastic reception by the large audience, whose gratitude was expressed most appositely by Dr D. W. Kent-Jones. The subject also attracted the attention of the local press, for it was understood consideration was being given to the installation of a refinery in Northern Ireland.

Two further lectures were arranged for the afternoon, the chairmen being Professors C. L. Wilson and C. Kemball, both of Queen's University. At the first, Professor G. Schwarzenbach of Zürich spoke on metastable protonation and deprotonation products in aqueous solution. Professor G. M. Schwab of Münich University followed this with a wide survey of modern views on heterogeneous catalysis, indicating the growing impact of various physical concepts on this subject.

On the Wednesday morning visits were arranged to the Ulster Print Works Ltd (textile printing and finishing), Berkshire Knitting (Ulster) Ltd (manufacture of nylon stockings) and the Ulster Weaving Co. Ltd (for yarn bleaching and weaving), and in the afternoon to International Computers and Tabulators Ltd and the Linen Industry Research Association. In addition, a display of ladies' fashions was organized and presented by the Irish Linen Guild.

In the evening the Joint Annual Dinner of the Institute and the Society in the Sir William Whitla Hall, Queen's University, was attended by more than 450 members and guests, the latter including many local dignitaries and their ladies. The Northern Ireland Government and Civil Service were represented in the persons of Lieut-Col. the Rt Hon. Lord Glentoran, P.C., H.M.L., M.P., Minister of Commerce, Sir Douglas Harkness, K.B.E., Permanent Secretary to the Ministry of Finance and Head of the Civil Service, and Professor H. G. Lamont, O.B.E., Chief Veterinary Research Officer, Ministry of Agriculture; and the Civic Authorities by the Lord Mayor of Belfast and Councillor J. G. Colhoun, Mayor of Londonderry. As representatives of Queen's University we were pleased to see Sir Frank Montgomery, M.C., Pro-Chancellor, Dr Michael Grant, C.B.E., Vice-Chancellor, and Mr G. R. Cowie, J.P., Secretary. Industry and commerce were represented by Sir Graham Larmor, a man with many interests in textiles and aviation, Mr J. E. Forde, C.B.E., President, Belfast Chamber of Commerce, Dr J. P. Dickson (Glasgow), Imperial Chemical Industries Ltd, Dr R. F. Goldstein, British Oxygen Chemicals Ltd, Mr G. N. Peters, Shell Mex & B.P. Ltd (Northern Irish Division) and Mr J. Kershaw, Shell Chemical Company Ltd (Northern Ireland). Other kindred societies were welcomed in the persons of Mr R. C. Chirnside, President, Society for Analytical Chemistry, and Dr A. K. Mills and Lieut-Col. F. J. Griffin, Vice-President and General Secretary respectively, Society of Chemical Industry. Mr H. D. Thornton, retiring Chairman, Dublin and District Section of the Institute, attended as a guest in recognition of the great part he had played in connection with the Joint Meetings in Dublin in 1952.

The Loyal Toast having been honoured, the Toast of The Society and The Institute was proposed by Lord Glentoran, who spoke of the close harmony between them, shown by their present meetings in Belfast and the previous joint meeting in Dublin, and outlined the part chemists in general could play in furthering the welfare of Northern Ireland, particularly its industry. Mr Herbert, in his reply, remarked that science, like Rugby football, is a common heritage of all Irishmen. He also reminded the assembly that as Sir Eric Rideal (the President of The Chemical Society) had occupied the chair at the Dublin dinner, it was agreed that the President of the Institute should do so on the next occasion. Professor H. J. Emeléus, C.B.E., F.R.S., retiring President of the Chemical Society, proposed the Toast of the Guests in a humorous speech that delighted all present. To this the Lord Mayor replied, again reminding the company of Northern Ireland's needs, particularly for an alternative fuel; he was followed by Dr Michael Grant, Vice-Chancellor of the University, who voiced the just pride of the City in its provision for chemical instruction and research and the pleasure the University had felt in being the centre of the present events.

THURSDAY, 7 APRIL

On Thursday morning The Chemical Society held its Annual General Meeting, after which Professor Emeléus delivered his Presidential Address on some noteworthy recent advances in fluorine chemistry, including the production of compounds with less usual component atoms, such as nitrogen, sulphur, silicon and boron. It was delivered with the ease and grace of an acknowledged master of his subject who has the ability to marshal new and apparently unrelated facts into a coherent pattern. His successor as President, Sir Alexander Todd, F.R.S., congratulated Professor Emeléus not only on this performance but also on his conduct as a notably successful holder of that office, and declared his intention to use his best endeavours to maintain the standard that he had set. Shortly afterwards the Officers and Council Members of the Society and the Institute met in the Great Hall for a luncheon at which the local representatives of the two bodies played the part of hosts.

Once again those not taking part in the business meetings were well provided with visits to firms in the area—Ulster Laces Ltd (lace and embroidery), Gallaher Ltd (manufacture of tobacco, cigarettes and snuff), the U.K. Optical Bausch and Lomb Ltd (lenses and spectacle frames) and Down Shoes Ltd (ladies' shoes). Coach tours to places associated with St Patrick, to Carrickfergus and Whitehead, to Newtownards, Greyabbey and Donaghadee, and a maritime tour of Belfast Harbour in the Harbour Commissioners'

vessel *Sir Thomas Dixon* were also arranged. A very popular reception, in the form of a wine-tasting session and buffet, preceded by a talk and film, was kindly provided by Messrs John Harvey and Sons, Bristol, at the Grand Central Hotel.

In the evening a large number of members and guests drove out of Belfast to the east, past the Ballymacarrett and Ballyhackamore districts, to the Parliament Buildings, Stormont, to enjoy a lavish reception provided by the Government of Northern Ireland. Guests were received by Lord and Lady Glentoran and, after an excellent buffet supper, were able to see the two Houses and to learn something of the history of these finely appointed hill-top buildings and their function in the life of the country. During the reception, music was provided by the Royal Ulster Constabulary Band.

FRIDAY, 8 APRIL

On the morning of Friday, 8 April, the only remaining business of the meetings, the Forty-Second Conference of Hon. Secretaries of Local Sections, was conducted in the Senate Room in the Main University building (*see* p. 183). A large number of members of both bodies had stayed on to take advantage of the all-day tours and the final reception. The coach tour to the remarkable basalt formations at the Giant's Causeway was popular, despite the deteriorating weather, the coastal route chosen offering some of the best scenery in the north-east of the country. Another tour, to the Mourne mountains, took visitors to the Spelga Pass, Newcastle and Tollymore Forest Park. A third party saw the Glens of Antrim, proceeding via Larne, the Coast Road, Cushenden, Glengariff and Broughshane. For those who had not yet had their fill of industrial tours, there were morning visits to Associated Electrical Industries Ltd, Larne (steam-turbine generators), the Ulster Brewery Co. Ltd, and the Department of Industrial and Forensic Science (corresponding to the Government Laboratory in London). One party went on an all-day visit to Stevenson & Son Ltd at Dungannon, to see the whole process of textile manufacture, including linen, rayon, nylon and Terylene, and another to Chemstrand Ltd, Coleraine, for the manufacture of Acrilan, and then to Fisons Milk Products Ltd, not far away.

In the evening the programme concluded with a reception and dance in the Sir William Whitla Hall, by invitation of the University in association with Imperial Chemical Industries Ltd. The guests were received by the Vice-Chancellor and Mrs Grant, together with Dr J. P. Dickson (I.C.I.) and Mrs Dickson. The music provided by the Tom Clarke Dance Orchestra was pronounced excellent by those knowledgeable in this specialized art, and the songs and dances provided by the Ulster Girls' Choir were enthusiastically applauded. There were also a number of prize dances, with which was incorporated a special examination in observation assessed from the stage by Professor C. L. Wilson.

ACKNOWLEDGEMENTS

An acknowledgement of the kindness and help of all those who joined in the effort to ensure the success of the meetings must surely begin with a special tribute to the herculean labours of the Northern Ireland Organizing Committee. Under the chairmanship of Dr A. J. Howard, who is also Chairman of the Belfast and District Section, all members of the Committee readily accepted personal responsibility for various aspects of organization. They would be the first to agree, however, that the main burden fell on Dr R. J. Magee, Honorary Secretary of the Committee, who carried out the gigantic task of co-ordinating activities, implementing decisions and maintaining close liaison with the administrative officers in London. Dr Magee, more than any other individual, deserves the gratitude of his fellow members for his outstanding contribution to the success of this memorable occasion.

Grateful thanks are also given to the Vice-Chancellor and Senate of the Queen's University of Belfast for their great kindness in providing, in addition to the Reception at the Whitla Hall, magnificent facilities for all the business meetings and for extending what can best be described as the freedom of the University to members and their guests.

To the Government of Northern Ireland, the Civic Authorities of Belfast, the directors of many industrial establishments who arranged works visits, and to all who helped in many other ways, the Council offers sincere thanks. The tradition of Northern Ireland for friendliness and generous hospitality was nobly upheld and was the hall-mark of an occasion that will long be remembered with pleasure and appreciation by all who took part.

Belfast Meetings.—The Presidential Address was published in April (*J.*, 126). The 82nd A.G.M. is reported opposite, and the 42nd Conference of Hon. Secretaries of Local Sections on p. 183. Articles on Belfast were published in the *Proc. Chem. Soc.* for February.

Lost Property.—A fur stole was found in the Sir William Whitla Hall after the Reception held on Friday, 8 April. The stole has been forwarded to the Institute and the owner is asked to communicate with the Finance Officer, at 30 Russell Square, London, W.C.1.

EIGHTY-SECOND ANNUAL GENERAL MEETING

The Eighty-Second Annual General Meeting of the Royal Institute of Chemistry was held in the Large Lecture Theatre, David Keir Building, The Queen's University of Belfast, Stranmillis Road, Belfast, on Wednesday, 6 April, 1960, at 10 a.m. Mr E. Le Q. Herbert, *President*, was in the Chair, and 145 corporate members signed the record of attendance. The notice convening the Meeting was read by the Secretary.

Before proceeding to the formal business of the meeting, the Chairman read messages of greeting and good wishes for the success of the Joint Annual Meetings from Dr J. W. Cook, F.R.S., Mr H. W. Cremer, C.B.E., and Sir Harry Jephcott, Past Presidents.

ORDINARY ANNUAL BUSINESS

Report of the Council and Report of the Benevolent Fund for the Year ended 30 September, 1959

The Chairman called first upon the Honorary Treasurer to present the Statements of Account (including those of the Fund for the Development of Education in Chemistry and other special Funds administered by the Institute) and the section of the Annual Report of the Council relating to Finance House and Staff Matters, together with the Report of the Benevolent Fund.

The Treasurer (Professor H. Burton) said that members who had studied the accounts had doubtless reached the conclusion that the present income of the Institute and the Benevolent Fund could properly be described, in general terms, as adequate but not excessive for the proper maintenance of activities. This equilibrium was what the Council had long been trying to achieve.

Commenting on the Report and Accounts of the Benevolent Fund, he drew attention to the fact that income from contributions of all kinds had been greater than ever before and, quite naturally, total disbursements had risen correspondingly, for it was the duty of those who administered the Fund to distribute available resources as fairly and generously as possible, while remembering the need to put something aside for use in less prosperous times whenever the opportunity arose. Happily, the current income of the Fund was sufficient to remove the threat of poverty from any member, or his dependent, but income could never be too great, for there should be no upper limit on generosity towards those in trouble.

In acknowledging the generous help given to the Fund the Treasurer announced that, under the Will of the late Mr William Moore, who had been a member for sixty-three years, the Fund would benefit to the extent of at least £3,000 and the Institute itself would receive a similar sum. This magnificent gift would be a valuable addition to capital resources. However, the Fund depended for its existence on thousands of smaller contributions, and any gift, no matter how small, was very welcome. As mentioned in the Report, only about one member in three was a regular contributor and until this proportion was more than doubled it could not be said that the Fund was receiving all the support that it needed and deserved.

Turning to the accounts of the Institute and the relevant section of the Annual Report, the Treasurer referred to the satisfactory margin between income and expenditure during the year under review. This served to confirm the view he had expressed at the previous Annual General Meeting that the position of the Institute appeared to have been stabilized after a long period of financial difficulty. With continuously expanding activities, however, fluctuations in income and expenditure were to be expected, and it would be wrong to regard the current balance of about £6,000 as an indication that future revenue was likely to be notably in excess of the Institute's needs. Several important factors that would affect the position could be foreseen, including the need to make more realistic annual provision for the replacement of the Institute's building. However, he was content to report that the present situation was not unsatisfactory and that the outlook in the immediate future could be viewed with confidence.

In conclusion, the Honorary Treasurer accorded his personal thanks to Mr Arnold for his work on behalf of the Benevolent Fund and to Mr Harding for his help in connection with financial matters.

The Chairman warmly endorsed the Honorary Treasurer's reference to the work of the Benevolent Fund. He wished that every member of the Institute could serve on the Committee that administered the Fund in order to see how much effort, sympathy and understanding was required—and was freely given.

In commenting on the Report of the Council as a whole, he referred to some matters of special interest, including those on which important developments had taken place since the end of the period covered by the Report. He first drew attention to the fact that the total number of graduate and corporate members at 30 September, 1959, had for the first time in the history of the Institute exceeded 15,000. The rate of increase was greater than in the last few years but was still not as high as it should be, having regard to the growing annual output of suitably qualified persons from universities and colleges. Nevertheless, there were signs that the position was improving. During the last few months some of the first candidates to obtain the Diploma in Technology with first or second class honours in Applied Chemistry had been admitted. The number of candidates with this qualification was expected to increase rapidly.

The first Institute examinations under the Special Relationship Scheme had also been held. The system had operated very satisfactorily, thanks to the close co-operation between the Institute's Assessors and the officers of the Technical Colleges concerned. The establishment of the Institute Research Diploma had also been an event of major importance. Although the regulations for the award had not been published until December 1959, 16 candidates—some working in technical colleges and others in industry and government service—had already been registered to undertake research for the award.

With regard to the section of the Report on professional status and employment, the Chairman referred to the widespread interest in the results of the latest survey of members' remuneration. It was gratifying to see that the Royal Commission on Doctors' and Dentists' Remuneration reported that the Institute was exceptional in having conducted a series of surveys that had come near to meeting their needs in this particular section of the field and had also provided useful guidance for the conduct of their own subsequent surveys.

In the publications field the taking over by the Institute of the management of advertisement business for the *Journal* had been smoothly effected, and a substantial increase in revenue had been achieved by the end of September, 1959. Progress had subsequently been well maintained, particularly since the introduction of the new format of the *Journal*. This important change had been generally well received and, among other advantages, it had given an opportunity of displaying the Institute's Armorial Bearings on the cover and of carrying much better illustrations than had previously been possible.

Activities in the educational field, sponsored by the Institute through the Fund for the Development of Education in Chemistry, had included the very successful Summer School in Analytical Chemistry, and the publication of the *Index of Chemistry Films* and the first two items in the series of *Monographs for Teachers*. These two monographs had proved very popular and a third had just been published. A good start had also been made in the production of a series of film strips for use as teaching aids.

In the March issue of the *Journal* an indication had been given that the Council had again been considering the possibility of doing something to look after the interests of those who reach the level of the Higher National Certificate in Chemistry but do not proceed or succeed in gaining admission to Graduate Membership. A further statement would be published in April, and full opportunity for wide discussion on all aspects of this problem would be given before any firm decisions on policy were taken (see *J.*, 122).

In a tribute to the work of Dr Ellingham and the other administrative officers—Mr Arnold, Dr Gibbs, Mr Winder, Mr Chisman and Mr Harding—the Chairman said that in the past year each of them had been specially concerned with working out the details of new developments and projects and putting them into effect, as well as with the growing ordinary business of the office. In visiting Local Sections one of the things he had particularly noticed was the esteem and regard in which the administrative officers were held by everyone. He also acknowledged the increasingly valuable services of two other members of staff: Mr R. W. Flack, in the administration of National Certificates and Diplomas, and Miss H. M. A. Garden, in the management of advertisement business for the *Journal*.

In a more personal capacity he expressed his sincere gratitude to Dr D. W. Kent-Jones, Past President, and said that owing to the death of Professor Wardlaw he had been called upon to preside over the Council without the aid and support of a past President serving on the Council. Nevertheless, he had been fortified by the knowledge that he could rely on Dr Kent-Jones to give wise guidance at any time and wished to thank him for his continued interest in the Institute for which he had previously done so much.

THE CHAIRMAN then formally proposed:

> *That the Report of the Council for the year ended 30 September, 1959, including the Statements of Accounts, be adopted.*

The motion was seconded by Mr P. F. Corbett.

Questions and comments were then invited on matters covered by the Report or arising from the observations of the Chairman and the Honorary Treasurer in presenting it.

MR H. WARD urged that further steps should be taken to secure the removal of the existing restriction on the investments held by the Benevolent Fund, which were limited to Trustee Securities and had suffered severe depreciation in value.

THE HONORARY TREASURER said that, as stated in the Report of the Fund, this problem had exercised the minds of the Committee for many years. Unfortunately the restriction was specified in rigid terms in the Trust Deed under which the Fund had been established, and the Institute's legal advisers had indicated that the outcome of an application to the courts for some modification of the restriction, which would involve the Fund in considerable expenditure, could not be predicted with any confidence. The Committee had recently decided to wait a little longer in the hope that impending legislation to widen the range of trustee investments would ease the situation.

In reply to a further question by Mr Ward, it was stated that representatives of the Institute had attended a meeting convened by the British Medical Association to explore the possibility of establishing closer co-operation among professional bodies. The value of informal consultations on matters of common concern had been emphasized.

There being no further questions, the resolution was put to the meeting and *carried unanimously.*

ELECTION OF OFFICERS, GENERAL MEMBERS OF THE COUNCIL AND CENSORS

At the request of the Chairman THE SECRETARY read the following report of the Scrutineers:—

'We have examined the ballot papers and report as follows:—

The total number of ballot papers received was 1,999, of which 1 was invalid. The votes were cast as under:

Censors

Harold Burton 1,990; Sir Christopher Kelk Ingold 1,988; Sir Harry Jephcott 1,989; Douglas William Kent-Jones 1,988

Votes for other eligible Fellows 4.

Vice-Presidents

Harry Julius Emeléus 1,989; Richard Alan Morton 1,988; George Rowntree Ramage 1,985.

Votes for other eligible Fellows 3.

Honorary Treasurer

Harold Burton 1,991.

General Members of Council

Harry James Barber 1,480; Leslie Young 1,408; William Bradley 1,369; Charles Mills Cawley 1,232; Robert William Bolland 1,109; Charles Forrester 1,044; John Edward Davis 1,019; Leslie Horton Williams Hallett 901; George Henry Bottomley 866; Herbert Harding Armstrong 810; John Rose 793; Harry Robert Jones 645.

Signed H. G. Smith
A. J. Feuell
Scrutineers

4 April, 1960.'

THE CHAIRMAN accordingly declared elected in their specified capacities:

Vice-Presidents: Professor H. J. Emeléus, C.B.E., F.R.S., Professor R. A. Morton, F.R.S., Dr G. R. Ramage.

Honorary Treasurer: Professor H. Burton.

General Members of the Council: Dr H. J. Barber, Dr R. W. Bolland, Professor William Bradley, Dr C. M. Cawley, C.B.E., Mr J. E. Davis, O.B.E., Dr C. Forrester, Professor Leslie Young.

Censors: Professor H. Burton, Sir Christopher Ingold, F.R.S., Sir Harry Jephcott, Dr D. W. Kent-Jones.

A vote of thanks to Dr H. G. Smith and Dr A. J. Feuell for their valuable work as Scrutineers was proposed by the Chairman and carried by acclamation.

VOTE OF THANKS TO THE RETIRING OFFICERS AND MEMBERS OF THE COUNCIL

DR A. J. HOWARD, in asking the meeting to accord a vote of thanks to the retiring Officers and Members of the Council, said that to lose the services of those who had given so much time and energy to the work of the Institute was naturally a matter for regret, but it was right that others should take their share in exercising these heavy responsibilities. He referred especially to the outstanding services rendered by Dr Norman Booth and Dr Frank Hartley, *Vice-Presidents.* The former had had a particularly difficult task in guiding the deliberations of the Professional Status Committee on matters of great complexity, and Dr Hartley had readily undertaken many special assignments in addition to his work as Chairman of the Ethical Practices Committee. Among the members of Council, Professor C. L. Wilson, who was also a member of the Northern Ireland Organizing Committee, had played a notable part in preparing for the Joint Annual Meetings in Belfast. All retiring Officers and Members of Council had made valuable contributions to the progress of the Institute and had earned the gratitude of members.

DR R. J. MAGEE seconded the vote of thanks, which was carried unanimously and with acclamation. Dr F. Hartley acknowledged this expression of appreciation.

ELECTION OF AUDITORS

PROFESSOR C. KEMBALL submitted a proposal that Dr D. I. Coomber and Dr K. G. A. Pankhurst be re-elected as Honorary Auditors for the year 1959-60. This motion, having been seconded by Dr J. Idris Jones, was put to the meeting and carried unanimously.

THE HONORARY TREASURER proposed that Messrs J. Y. Finlay, Robertson and Co., Chartered Accountants, be re-elected as professional auditors of the Institute for the year 1959-60 at the established fee of 225 guineas. The motion was seconded by Mr N. F. Rapps and carried unanimously.

PROFESSOR C. L. WILSON proposed that a vote of thanks be accorded to Dr Coomber and Dr Pankhurst for the services that they had given as Honorary Auditors, and this proposal was approved with acclamation.

Conclusion

On the proposal of the Chairman, it was unanimously agreed that the thanks of the Institute be accorded to the authorities of The Queen's University, Belfast, for providing facilities for holding the Annual General Meeting in the David Keir Building.

The meeting was then declared closed.

OFFICERS AND MEMBERS OF COUNCIL, 1960-61

President

Ernest Le Quesne HERBERT, B.SC., F.H.-W.C., M.I.CHEM.E., F.INST.F., F.INST.PET.

Vice-Presidents

Harry Julius EMELÉUS, C.B.E., PH.D., D.SC., A.R.C.S., F.R.S.
Clifford Walter HERD, B.SC., PH.D.
Charles KEMBALL, M.A., PH.D.
Richard Alan MORTON, PH.D., D.SC., F.R.S.
Clifford PAINE, B.SC., F.S.D.C.
George Rowntree RAMAGE, PH.D., D.SC., F.S.D.C.

Hon. Treasurer

Harold BURTON, PH.D., D.SC.

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William Rogie ANGUS, M.A., PH.D., D.SC. : *North Wales*
Leonard BALMFORTH, B.SC : *Sheffield, South Yorkshire and North Midlands; Hull and District*
Harry James BARBER, PH.D., D.SC.
Frank BELL, PH.D., D.SC., F.R.S.E. : *Edinburgh and East of Scotland; Stirlingshire and District*
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Charles Mills CAWLEY, C.B.E., PH.D., D.SC., A.R.C.S., D.I.C., F.INST.PET., F.INST.F.
Sylvester John Herbert Owen CHARD, M.SC., DIP.ED. : *South Wales; Cardiff and District*
Ernest Harrison COULSON, M.SC., A.R.C.S., D.I.C.
Denis CROWLEY, M.SC., F.I.C.I. : *Dublin and District*
John Edward DAVIS, O.B.E., M.INST.GAS E., F.INST.F.
George DRING, M.A., B.SC., M.I.CHEM.E., F.P.I.
Albert Norman EDMONDSON, F.P.I. : *Cumberland and District; North Lancashire*
Reginald Langham ELLIOTT, B.SC., PH.D., F.T.I., F.S.D.C. : *Leeds Area; Huddersfield*
Sidney John FLETCHER, B.SC., PH.D., D.L.C. : *Manchester and District*
Charles FORRESTER, PH.D., F.H.-W.C., A.M.I.CHEM.E., F.INST.F., F.R.S.E.
Robert Albert Ernest GALLEY, B.SC., PH.D., A.R.C.S., D.I.C. : *Overseas*
Donald Clarence GARRATT, PH.D., D.SC.
Frederick Denison Maurice HOCKING, M.SC., M.B., B.S., M.R.C.S., L.R.C.P., A.C.G.F.C., M.I.BIOL. : *Bristol and District; South-Western Counties*
Herbert Henry HODGSON, M.A., B.SC., PH.D., F.S.D.C.
Frederick Cecil HYMAS, M.SC. : *London; East Anglia* (1)
Sir Christopher Kelk INGOLD, D.SC., A.R.C.S., D.I.C., F.R.S.
William Ford KIRKPATRICK, A.H.-W.C., F.I.C.I. : *Belfast and District*
Sir Harry Work MELVILLE, K.C.B., PH.D., D.SC., F.R.S.
Samuel Aaron MILLER, M.A., B.SC., PH.D. : *London; East Anglia* (2)
Mamie OLLIVER, M.SC.
Richard Eric PARKER, B.SC., PH.D. : *Mid-Southern Counties; Thames Valley*
Leonard Powell PRIESTLEY, B.SC., DIP.ED. : *East Midlands*
Patrick Dunbar RITCHIE, B.SC., PH.D., F.P.I., M.I.CHEM.E., F.R.S.E. : *Glasgow and West of Scotland*
Frank Arnold ROBINSON, M.SC.TECH., D.SC., LL.B.
Henry Norman RYDON, M.SC.TECH., PH.D., D.PHIL., D.SC., A.R.C.S., D.I.C.
Charles SIMONS, B.SC., PH.D., A.R.C.S., D.I.C., Barrister-at-Law
Carl Christian SKOU, M.SC., M.I.CHEM.E. : *Newcastle upon Tyne and North-East Coast; Tees-side*
Arthur Joseph Victor UNDERWOOD, D.SC., M.I.MECH.E., M.I.CHEM.E., F.INST.PET., F.INST.F., M.CONS.E.
Ernest James VAUGHAN, M.SC., A.R.C.S., D.I.C., F.I.M.
Ralph Louis WAIN, PH.D., D.SC., F.R.S.
Mearns Bruce WATSON, B.SC., PH.D. : *Aberdeen and North of Scotland; Dundee and District*
Percy Noel WILLIAMS, M.SC. : *Liverpool and North-Western*
Walter WILSON, PH.D., D.SC., A.R.C.S., D.I.C. : *Birmingham and Midlands*
David WOODCOCK, PH.D., D.SC.
Leslie YOUNG, PH.D., D.SC., A.R.C.S.

(District Members of Council are indicated by references in italics to the Local Section(s) within their Districts)

OCCUPATIONAL CATEGORIES

For the information of members, the Officers and Members of Council for 1960–61 are listed under occupational categories below. An asterisk indicates those not serving in any capacity in 1959–60. Registered addresses are in London or Home Counties unless otherwise indicated.

Industry

*Dr H. J. Barber, Research Controller, May & Baker Ltd
Mr George Dring, Consultant, formerly Research Director, Bakelite Ltd (Solihull)
Mr A. N. Edmondson, Chemist to the Group, Birtwistle & Leigh, Preston.
Dr S. J. Fletcher, Technical Director, Magnesium Elektron Ltd, Manchester
Dr D. C. Garratt, Chief Analyst, Boots Pure Drug Co. Ltd, Nottingham
Mr E. Le Q. Herbert, *President*, Managing Director, Shell Refining Co. Ltd
*Mr F. C. Hymas, Chief Chemist, Phillips Yeast Products Ltd
*Dr S. A. Miller, Manager, Basic Research Dept, British Oxygen Research & Development Ltd
Miss M. Olliver, Chief Research Chemist, Connaught Food Products Section of the Schweppes Research Laboratories
Mr Clifford Paine, *Vice-President*, Director, Imperial Chemical Industries Ltd
Dr F. A. Robinson, Director of Research, Allen & Hanburys Ltd
Dr Charles Simons, Factory and Production Manager, Weddel Pharmaceuticals, Division of the Union International Co. Ltd
Mr C. C. Skou, Works Manager, Imperial Chemical Industries Ltd, Billingham Division
Mr P. N. Williams, formerly Divisional Manager, Research Dept, Unilever Ltd (West Kirby, Cheshire)
Dr Walter Wilson, Research Manager, British Industrial Plastics Ltd, Oldbury

Nationalized Industry

*Mr J. E. Davis, O.B.E., Chief Technical Officer, South Eastern Gas Board, Croydon

Government Service

*Dr C. M. Cawley, C.B.E., Chief Scientist, Ministry of Power
*Dr Charles Forrester, Scientist, Ministry of Power
*Dr R. A. E. Galley, Director, Tropical Products Institute, Dept of Scientific and Industrial Research
Sir Harry Melville, K.C.B., F.R.S., Secretary, Department of Scientific and Industrial Research
Mr E. J. Vaughan, Director of Materials Research, Royal Naval Scientific Service

Hospital

Dr F. D. M. Hocking, Consulting Pathologist, Royal Cornwall Infirmary, Truro

Industrial Research Association

*Mr W. F. Kirkpatrick, Head of Chemistry Dept, Linen Industry Research Association, Lisburn, Northern Ireland

Independent Consulting Practice

Dr C. W. Herd, *Vice-President*, Analytical and Consulting Chemist
Dr A. J. V. Underwood, Consulting Chemical Engineer

University

*Dr W. R. Angus, Senior Lecturer in Physical Chemistry, University College of North Wales, Bangor
Professor William Bradley, Professor of Colour Chemistry and Dyeing, University of Leeds
Professor Harold Burton, *Hon. Treasurer*, Professor of Chemistry, University of London, Queen Elizabeth College
Mr S. J. H. O. Chard, Lecturer in Chemistry, University College, Cardiff
*Mr Denis Crowley, Lecturer in Agricultural Chemistry, University College, Dublin
*Professor H. J. Emeléus, C.B.E., F.R.S., *Vice-President*, Professor of Inorganic Chemistry, University of Cambridge
Professor Sir Christopher Ingold, F.R.S., Professor of Chemistry, University of London, University College
Professor Charles Kemball, *Vice-President*, Professor of Physical and Inorganic Chemistry, Queen's University, Belfast
Professor R. A. Morton, F.R.S., *Vice-President*, Professor of Biochemistry, University of Liverpool
Dr R. E. Parker, Lecturer in Organic Chemistry, University of Southampton
Professor H. N. Rydon, Professor of Chemistry, University of Exeter
Professor R. L. Wain, F.R.S., Professor of Agricultural Chemistry, University of London, Wye College
Dr David Woodcock, Research Organic Chemist with status of Senior Lecturer in the University, University of Bristol Research Station, Long Ashton
*Professor Leslie Young, Professor of Biochemistry, University of London, St Thomas's Hospital Medical School

College of Technology related to University

*Professor Frank Bell, Professor of Chemistry, Heriot-Watt College, Edinburgh
*Professor P. D. Ritchie, 'Young' Professor of Chemical Technology, Royal College of Science and Technology, Glasgow

Technical College

Mr Leonard Balmforth, Head of the Chemistry and Biology Dept, College of Technology, Hull
*Dr R. W. Bolland, Head of Dept of Chemistry and Biology, College of Technology, Bristol
*Dr R. L. Elliott, Head of Dept of Chemical Technology, Institute of Technology, Bradford
Dr H. H. Hodgson, formerly Head of Depts of Chemistry and Colour Chemistry, Technical College, Huddersfield (St Annes-on-Sea, Lancs.)
Mr L. P. Priestley, Head of School of Chemistry, College of Technology, Leicester
Dr G. R. Ramage, *Vice-President*, Head of Dept of Chemistry and Applied Chemistry, Royal Technical College, Salford
Dr M. B. Watson, Head of Chemistry Dept, Robert Gordon's Technical College, Aberdeen

School

Mr E. H. Coulson, Senior Science Master, Braintree High School, Essex

ADVANCES IN PLANT BIOCHEMISTRY

IN RELATION TO CELL STRUCTURE*

By D. D. Davies, B.Sc., PH.D.
Department of Botany, King's College, London

Biochemistry has its foundations in chemistry, but owes its special characteristics to the effects of structure and organization on chemical reactions. The interplay of structure and function is to be found at all levels of biological organization. Thus the transmission of genetic information is thought to be based on the coded sequence of nucleotides in nucleic acid; the stereospecificity of enzymes is based in the asymmetry of enzyme surfaces, and essentially similar relationships of form and function are studied by anatomists and morphologists.

Multi-enzyme systems show an ordered sequence of reactions in a soluble system because, as pointed out by Sir Frederick Gowland Hopkins, enzymes are specific for their substrates. The product of one enzyme is the substrate for the next enzyme in the sequence and is not a substrate for other enzymes in the cell. In a factory, a component may be subjected to an ordered sequence of drilling and cutting. The component passes along a conveyor belt and is treated in a predetermined order, because the machines are positioned in that order. Organization in free solution is possible because any enzyme in a sequence can only act on molecules which have been modified by previous enzymes in the sequence.

One of the best known metabolic sequences is the Krebs cycle. The sum of reactions within the cycle is

(1) $CH_3COOH + 2O_2 \longrightarrow 2CO_2 + 2H_2O$

so that the Krebs cycle functions as a respiratory mechanism in which acetate is completely oxidized, and the cycle cannot produce an increase in the amount of cycle intermediate. However, the Krebs cycle also has a biosynthetic function and provides oxaloacetate and α-oxoglutarate for the synthesis of their corresponding amino acids. The utilization of glutamate for protein synthesis removes α-oxoglutarate from the cycle, tending to lower the concentration of cycle acids, and, in the absence of a mechanism for producing a cycle intermediate, respiration via the Krebs cycle would stop.

Plants are able to produce cycle acids by means of carbon dioxide fixation:

(2) Phosphopyruvate + CO_2 ⟶ oxaloacetate + P_i

(3) Pyruvate + TPNH + H^+ + CO_2 ⟷ malate + TPN^+

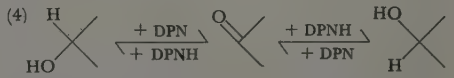
and it is for this and other reasons that the dark fixation of carbon dioxide is essential for life.

The reductive carboxylation of pyruvate to form malate is essentially the reverse of malate oxidation:

malate + DPN^+ ⟷ oxaloacetate + DPNH + H^+

The simultaneous functioning of both reactions is possible because different coenzymes are involved—triphosphopyridine nucleotide (TPN) and diphosphopyridine nucleotide (DPN). A consequence of the fact that the cells employ two enzymes for oxido-reductions is that in certain cases the cell can effect what may be called a 'push–pull' method of synthesis.

The biological significance of this mechanism is made clear by first considering a reaction involving an oxido-reduction and only one coenzyme. The enzyme galactowaldenase catalyses the Walden inversion of uridinediphosphate glucose and uridinediphosphate galactose. Epimerization at C–4 of the hexose involves the reactions

(4) 

The coenzyme has a catalytic role and cannot affect the equilibrium ratio, which is 3:1 in favour of the glucose nucleotide.

The equilibrium of the reaction

pyruvate + CO_2 ⇌ oxalo acetate

favours decarboxylation, but by means of the reactions

(5) Pyruvate + CO_2 ⟷ (TPNH / TPN) malate ⟷ (DPN / DPNH) oxaloacetate

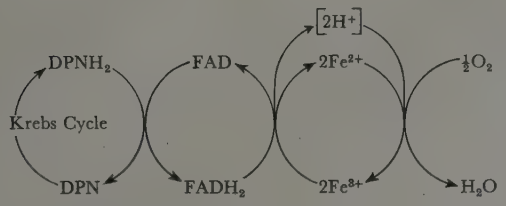
the cell can achieve a net synthesis of oxaloacetate by 'pushing' the reaction by means of a high TPNH:TPN ratio and 'pulling' by means of a high DPN:DPNH ratio.

Spatial separation of the systems utilizing TPN and DPN is critical for the organization of synthetic reactions. To achieve synthesis the cell must provide high-energy anhydrides, such as the 5′(pyro)-triphosphate of adenosine (ATP), in an aqueous medium and highly reduced compounds such as TPNH ($E_0 = -0{\cdot}32V$) in a potentially oxidizing medium.

Adenosine triphosphate is formed in mitochondria, which are more or less spherical organelles about 1μ in diameter and limited by a double membrane. Mitochondria catalyse the complete oxidation of pyruvate via the Krebs cycle, and each oxidative step,

* Based on a lecture to the London Section, 21 October, 1959.

other than the oxidation of succinate, involves a DPN-specific enzyme. The reactions of the Krebs cycle can be considered as a mechanism for providing reduced DPN as a substrate for an electron-transporting system which is located in the double membranes of the mitochondria. The system involves the transfer of hydrogen from DPNH to a flavoprotein and the transfer of electrons through the cytochrome system:



As electrons pass through this system a coupled system catalyses the reaction

$$ADP + P_i \xrightleftharpoons{H_2O} ATP$$

Consequently it is in the lipid-rich membranes that ATP is formed, and this substance is the precursor of many other anhydrides involved in biosynthesis.

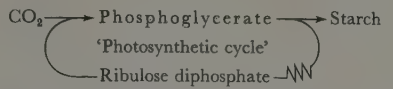
Outside the mitochondria, and thereby separated from the electron-transporting system, are the enzymes of the so-called pentose phosphate cycle which catalyses the overall reaction

$$C_6H_{12}O_6 + 12TPN^+ + 6H_2O \longrightarrow 6CO_2 + 12TPNH + 12H^+$$

and thus produces the reducing potential necessary for biosynthesis.

By the use of different coenzymes and the spatial separation of two metabolic pathways the cell is able to oxidize carbohydrates and simultaneously produce high-energy anhydrides and a reducing potential.

In recent years attention has been drawn to the control of plant metabolism by negative feed-back mechanisms. For example, oxaloacetic acid, an intermediate in the Krebs cycle, is an inhibitor of one of the enzymes of the cycle—succinic dehydrogenase. Consequently, if the rate of oxaloacetate production exceeds that of its removal, the increased concentration of oxaloacetate will lower the rate of synthesis of oxaloacetate in much the same way as a thermostat regulates heating. The effect of positive feed-back mechanisms has received rather less attention. If a microphone is placed in front of the loudspeaker of a radio and connected to the gramophone input, part of the speaker output is fed back to the amplifier thereby increasing the speaker output, which rises to a maximum when the amplifier or speaker is functioning at maximum power. Positive feed-back provides a mechanism for operating a system at full capacity, and an example is to be found in the dark reactions of photosynthesis:



The photosynthetic cycle is a relatively complex set of reactions whereby carbon dioxide is converted to phosphoglycerate. Because phosphoglycerate is a reactant as well as a product of the cycle, it can be fed back into the cycle, increasing the concentration of the cycle intermediates and thereby ensuring the maximum rate of operation. Thus in the dark the concentration of cycle intermediates is low, the concentration of ribulose diphosphate being less than 5×10^{-4} μ-mole/ml of algae, but because of positive feed-back, the concentration of cycle intermediates rises in the light; thus the ribulose diphosphate concentration increases by a factor of 10^3.

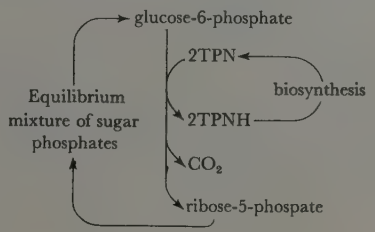
The enzymes playing a part in the photosynthetic cycle are found in the chloroplasts, but most of the enzymes are also found outside the chloroplasts where they participate in the oxidation of carbohydrates via the pentose-phosphate pathway. The reactions of this pathway are conventionally written in the form of a metabolic cycle, and the enzymes are thought by many workers to be in free solution. These views are fundamentally opposed. The organization of a metabolic pattern in free solution requires that the enzymes have a high degree of substrate specificity, but at least three of the enzymes involved in the pentose-phosphate pathway have wide substrate specificities. The range of substrate specificity evinced by transketolase is shown in Table I. Because of the lack of specificity of trans-

TABLE I

SUBSTRATE SPECIFICITY OF TRANSKETOLASE

Glycolaldehyde donors	Glycolaldehyde acceptors
Hydroxypyruvate	Glycolaldehyde
L-Erythrulose	DL-Glyceraldehyde
Xylulose-5-phosphate	Phosphoglyceraldehyde
Fructose-6-phosphate	Erythrose-4-phosphate
Sedoheptulose-7-phosphate	Ribose-5-phosphate
Octulose-8-phosphate	Allose-6-phosphate

ketolase, it is possible to construct at least two formal pentose-phosphate cycles. Consequently, if the enzymes



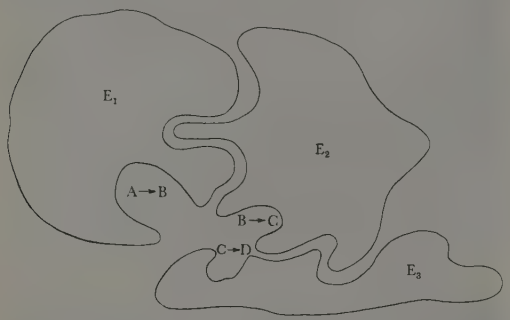
of the pentose pathway are in free solution they cannot produce an ordered sequence of events such as is presented in a cycle. With the exception of the oxidative steps of the pathway, all the reactions are readily reversible. Consequently, the pathway may be considered as forming a pool of sugar phosphates, maintained in a state of dynamic equilibrium in which the rate of carbohydrate oxidation is determined by the turnover of TPN.

Though the enzymes of this pathway do not appear to be associated with a structure detectable under the electron microscope, it is nevertheless possible that the enzymes are connected to one another in a sort of three-dimensional mosaic or jig-saw.

Consider the sequence

$$A \xrightarrow{E_1} B \xrightarrow{E_2} C \xrightarrow{E_3} D$$

The product of each enzyme must diffuse to the next enzyme in the sequence; the transit time would be reduced if the system was enclosed by a membrane or if the enzymes were held together in such a way that the reaction sequence is reflected in the three-dimensional arrangement of the enzymes in some such way as shown in the figure below:



These views have been developed by D. E. Green, who suggests that the large size of enzyme molecules can in part be attributed to the need for specific protein interactions, in the construction of multi-enzyme complexes. In support of this view he notes that enzymes involved in the oxidation of fatty acids are difficult to separate when they are functionally connected. Similarly, it is difficult to separate enzymes of the pentose-phosphate pathway; thus crystalline preparations of transketolase are contaminated with phosphoketopentose epimerase, which is only removed with great difficulty. There are many more examples of an apparent physical association between enzymes that are functionally connected. On the other hand, present-day techniques for protein purification are relatively crude, and further evidence is necessary before the existence of physically associated multi-enzyme systems can be taken as established.

Book Reviews

SOME PROBLEMS IN CHEMICAL KINETICS AND REACTIVITY. Volume I. Pp. xii + 239. Volume II. Pp. 331. N. N. Semenov. Translated by M. Boudart. *Princeton: University Press; London, Oxford University Press*, 1959. 36*s*. each.

A quarter of a century ago Semenov published his classic work *Chemical Kinetics and Chain Reactions*, which had an immense and beneficial effect on the progress of reaction kinetics. In 1954, the same author completed a second book entitled *Some Problems in Chemical Kinetics and Reactivity*, which he revised in 1957 and to which an Appendix (III of the present book) was added in 1959. The English translation of the revised Russian text appeared in two volumes in January and late August 1959. Because of my veneration of the author I was determined to give all the time necessary to a leisurely and detailed perusal of both volumes. Chemically this has been a most stimulating experience but unfortunately even the deep euphoria induced by the comforts of a calm Atlantic sea crossing was not proof against the many irritations caused by the deplorably low standard of production. The names of many European and American authors are mis-spelled, presumably because they have undergone the double transliteration from English to Russian and back. The translator has not verified the references or ensured the correct spelling of common words and technical terms. The consequences of this very slipshod work are generally severe handicaps to the reader and are only occasionally amusing (Messrs Wilmarth and Szwarc would be astonished at their alleged collaboration on page 84, Volume I). Thus it takes time to discover that over one-third of the references to Chapter I and all those to Sections 7 and 8 of Appendix III are misnumbered and that some of the references to Appendix II are missing. A book of almost 600 pages by an author of Semenov's distinction and breadth of interest, which is important and should certainly be widely read, surely deserves at least a subject index. Perhaps the nine blank pages at the end of volume II are for those indexes which the reader has compiled for himself.

The text is fascinating. Its great value is that it is a coherent account, in English, of the current climate of opinion in the very important Russian school of gas kineticists and gives many of their experimental results in useful detail. Those of us who are too idle, or unable, to follow the Russian literature cannot be too grateful to the author and translator for performing this service. The book includes and extends much of the subject matter of the author's *Chain Reactions* but includes much else besides. The contents are very adequately indicated by the titles of the chapters: reactivity of monoradicals; competition between monoradical reactions; reactions of diradicals; dissociation of

molecules and recombination of radicals; initiation of chain reactions by ions of variable valence; wall initiation and termination of chain reactions; competition between chain reactions and reactions between saturated molecules; thermal explosions; chain ignition; chain ignition in hydrogen–oxygen mixtures; chain interaction; and chain reactions with degenerate branching. The book also contains, in the Appendixes, elementary commentaries on the transition state theory by Temkin and Sokolov.

The theory of chain reactions enables an investigator to make certain deductions from the dependence of the reaction on pressure, temperature, surface–volume ratio, additives and so on. He can usually say with a high degree of confidence where the chains start, whether they are branched and if so whether linearly or quadratically, and how and where they are terminated, and hence he can often accurately predict what will be the effect of changing certain experimental conditions. To go further and identify the precise reaction mechanism unambiguously and determine the rate constants of the various component elementary steps is often insuperably difficult, especially for explosive oxidations, with the result that for some reactions the number of mechanisms is not far short of the number of investigators. The validity of many of the extremely elaborate, detailed and often numerical, arguments advanced by Semenov in favour of certain mechanisms is arguable. This is particularly true of the repeated use, as definitive criteria of mechanisms, of values of rate constants for radical reactions based on assumed frequency factors and linear relationships between energies of activation and heats of reaction. Sometimes there is an astonishing lack of sense of chemical reality about these calculations. A notable example is provided by the calculations (p. 202 of volume I) of the properties of aqueous solutions containing ferrous and ferric ions, which entirely neglect the hydrolytic and solubility equilibria which are involved, so that we are led to believe that Fe^{3+} exists in μM solution of ferric salts at pH 13!

It is interesting to discover that the development of the subject in Russia has followed broadly similar lines to those elsewhere, although some differences of emphasis exist, for example, quadratic branching and radical isomerization have commanded considerably more attention in Russia. The author has either ignored or overlooked many significant Western publications, a fact which inevitably detracts from the book as a balanced appreciation of the present state of knowledge, but he does so to an extent which is far less than the degree to which most Western authors ignore Russian publications. The reader who can make good this deficiency from his own resources will find these two volumes stimulating and vitally important and will be glad to read and re-read them.

F. S. DAINTON

THE PHYSICO-CHEMICAL CONSTANTS OF BINARY SYSTEMS IN CONCENTRATED SOLUTIONS. VOLUME III. Systems with Metallic Compounds. J. Timmermans. Pp. xiii + 1322. *New York: Interscience Publishers Inc.; London: Interscience Publishers Ltd*, 1960. 270*s*.

In this, the third volume* of his compilation, Professor Timmermans presents the results of his vast collection of physico-chemical data on binary systems containing one or more inorganic constituents. As would be expected, aqueous mixtures take up a great part of the book. Indeed, out of 1322 pages of tables no fewer than 728 are devoted to binary systems of which water is one component.

Apart from aqueous systems, the other main divisions in which the tables are organized are systems of two metallic salts and systems of one metallic salt with a second compound which is not a salt but may be an organic compound or one containing the hydroxyl group. These simple categories, however, do not in fact suffice to classify all the material now brought together, and it is not obvious that the order in which data are arranged follows any all-embracing systematic plan. Why for example are solutions of salts in *heavy* water separated by 200 pages from corresponding data for *natural* water? And where would one expect to find data on the dissociation pressures of metallic hydrides or nitrides (p. 1224) or even on occasion data on ternary systems (p. 1060)? It is to be hoped that the fourth volume, containing an index which will serve as a key to the whole work, will soon make its appearance.

The chief physico-chemical constants to which attention is paid are vapour pressures, densities and coefficients of expansion and compressibility, freezing points, eutectics and transition points, viscosities and surface tensions, refractivities and optical dispersions, dielectric constants, electrical conductivities, optical rotations, magnetic rotations and susceptibilities, and thermal constants such as specific heats, heats of solution, vaporization and fusion, and thermal conductivities. Various other data may also be found—composition of isopiestic solutions, osmotic coefficients, X-ray absorptions, temperatures of spontaneous crystallization, transport numbers, critical solution temperatures, dissociation pressures and velocities of sound. Occasionally there is insufficient explanation of what the numerical data refer to (*e.g.* p. 37 Dewing, 1955; p. 109 Lepinskikh, Esin and Shavrin, 1956). Sometimes no more is given than a reference (*e.g.* to Raman spectra, lattice constants or crystal structure).

The reader may be puzzled to know (since he is nowhere told) to which component of any binary a figure for percentage composition refers, and he may

* For reviews of previous volumes, *see J.*, 1960, 18, and 1959, 372.

doubt whether the compiler has always been consistent (cf. p. 1231, Biltz and Meinecke, and Kordes).

An indication of the character of the work is given in the 40 pages devoted to aqueous solutions of common salt. Some of the references date back 100 years or more and cite data of problematical accuracy (vapour pressure, 1858: b.ps 1835, 1856: f.ps 1843, 1862: densities, 1846, 1850: etc.). Even in the more recent work considerable discrepancies appear in measurements by different hands. Strictly speaking a large proportion of the figures printed in these tables are meaningless, and the critical selection and evaluation of data is a task which has been left to the user.

Solubilities are not treated explicitly, but the reader will find in tables of f.ps and b.ps (pp. 306, 308) a considerable quantity of implicit data. The table on p. 308 (freezing points, Poggiale, 1843) appears in fact to be a table of solubilities against temperatures in which columns 3 and 4 have been transposed in error. On p. 307 (Styriakovich and Khaibullin, 1956), kg, repeated many times, is apparently a typing error for P_{kg}.

One could wish that greater consistency of usage had been secured in the typescript from which the tables have been reproduced. For example, on p. 339 (Staub, Scholz, Winkelmann) the minus sign before the first value in a column is understood to apply to all succeeding lower figures, but in another table (Young and Machin) every value in a column is given a minus sign. (This is all the more surprising because in Young and Machin's table the figures purport to be values for molar heat capacity, which cannot under any circumstances be negative.)

This great new work of reference could not have been made available to the chemical world except for the support and sponsorship of the National Science Foundation and the Union Minière du Haut-Katanga. To them and to Professor Timmermans innumerable chemists will be grateful for the time and effort this work, in spite of its imperfections, will save. Every science library will need it.

E. A. COULSON

THE EFFECTS OF POLLUTION ON LIVING MATERIAL. Symposia of the Institute of Biology, No. 8. Edited by W. B. Yapp. Pp. xii + 154. *London: The Institute of Biology*, 1959, 25*s*.

This symposium, by a group of experts, summarizes recent information on the effects of various kinds of pollution in rivers, estuaries and on land, including some effects of atmospheric and radioactive pollution. While the emphasis is on the biological aspect, the book is of great interest to chemists who have to consider the condition of rivers for water supply or fish life, or those who deal with atmospheric and radioactive pollution.

The first half deals with the biological effects of pollution upon the abundance and types of animal life in rivers and estuaries. Aspects of the carbon, nitrogen and sulphur cycles in the Thames estuary are also discussed. The authors stress that there are in this country many polluted rivers, fishless, foul and unsightly, and also state that the condition of many estuaries constitutes an impassable barrier to fish, such as salmon, that spend part of their life cycle in the sea. Some industrial wastes are not decomposed during sewage purification and may have toxic effects upon water plants and the lower forms of animal life.

Three of the papers deal with the effects of atmospheric pollution, the result of the burning of coal, and of the emission of fumes from chemical factories and motor vehicles. There is also a discussion on fluorosis in farm animals, to which cattle are especially susceptible.

The final third of the book deals with the important problems of the disposal of radioactive wastes, the uptake of fission products by plants and aquatic organisms and the genetic effects of radioactive pollution, problems which are increasingly exercising chemists engaged in the analysis of food and water. The information given in these chapters is in itself a cogent reason for acquiring the book.

The discussions following the various papers are given, as well as copious references, and the book can be confidently recommended to the biologist, the chemist and the general reader.

W. G. CAREY

ISOTOPIC TRACERS. Second Edition. G. E. Francis, W. Mulligan and A. Wormall. Pp. 523. *University of London: The Athlone Press*, 1959. 52*s*. 6*d*.

The first edition of this book, published in 1954, was widely welcomed as providing a helpful introduction to the application of isotopic tracer methods in the biological sciences. A new edition was made desirable, almost necessary, by the elaboration of new techniques in this field, and by the greatly increased use to which isotopic tracers have been put in many biological disciplines. A few chapters have been left essentially unchanged but most of the book has been rewritten with the aim, in which the authors have succeeded, of bringing the most useful advances to the notice of the biological research worker. The chapter on the synthesis of labelled compounds has been considerably modified and enlarged, and a critical and balanced comment is made on the radio-iodination of proteins, which is widely used in following the metabolism of plasma constituents and other proteins of special biological interest. The chapter dealing with the measurement of stable isotopes has also been brought up to date, particularly by the inclusion of a description of the determination of deuterium by a density method. It was obvious that the part of the book dealing with the measurements of radioactive isotopes had to be completely rewritten, and the authors give a very useful account of new techniques, particularly those involving

scintillation counters. Data on the characteristics of various phosphors and a comparison of the efficiency of different types of geiger and scintillation counters are especially useful. Most other chapters in the book have been brought up to date, and such criticisms as have been expressed by reviewers of the first edition have been taken into account in revising the book. The layout is very satisfactory, the illustrations are clear, and the book seems to be remarkably free of printing errors.

A. NEUBERGER

INSTRUMENTATION AND COMPUTATION IN PROCESS DEVELOPMENT AND PLANT DESIGN. Proceedings of the Joint Symposium, May 1959. Edited by P. A. Rottenburg. *London: The Institution of Chemical Engineers*, 1959. Pp. 175. 80*s*. (60*s*. to members of sponsoring bodies.)

This volume contains the full text of the 18 papers presented at the five sessions of the symposium with a report on the discussion at each session, and the concluding address by Sir Harold Hartley.

The opening session deals with improvement of process efficiency, in two papers on the practical application of statistical methods to plant control and two on the application of computers in studying plant operation. Session 2, on process control systems, includes papers on the use of a computing programme to establish optimum conditions in a process for deuterium production and on a ratio flow controller for in-line blending. The application of on-line computers forms the subject matter of Session 3 and includes accounts of the operation of a simple analogue computer for chemical plant control purposes and a data-processing machine installed for the protection of a nuclear power reactor; new control techniques in rolling mills are also surveyed. In Session 4, problems in the design of analogue computers for process control are discussed, and their application to the study of the cold-rolling process and distillation-column control is examined. The fourth paper deals with analogue computing applied to the economic estimation of plants and processes and—unlike the majority of the papers presented—discusses aspects of design other than control. Session 5 comprises two papers on the use of computer techniques in large and small companies. These papers, in which the types of problems handled and the organization and cost of computer services are discussed, are of general interest.

The well-informed discussion enhances the value of the papers.

The concluding address gives a brief, but admirably balanced, survey of the subject matter of the symposium and an outline of the potential of the new methods for attaining plant optimization and integrated control (see *J*., 1959, 404).

The overall impression is that control engineering, despite the marked progress in recent years, is yet only in its infancy. The new trends in instrumentation and control are based mainly on data handling, electronics and new techniques, and are directed largely towards production by the most economical means. General acceptance of the new methods may not come readily; their successful development presents a challenge, with the economics of their introduction an essential consideration.

The subject matter, despite its practical and theoretical importance, may not have a universal appeal, but anyone interested in the control of chemical or mechanical processes, especially from the technical or economic aspect, will find this well-produced volume informative and most stimulating.

M. F. SAWYER

UNITIZED EXPERIMENTS IN ORGANIC CHEMISTRY. R. Q. Brewster, C. A. VanderWerf, and W. E. McEwen. Pp. xii + 200. *Princeton: D. Van Nostrand Co. Inc.; London: D. Van Nostrand Co. Ltd*, 1960. 41*s*. 6*d*.

Professor T. L. Cottrell's inaugural lecture to the University of Edinburgh (see *J*., 57) has probably intensified the doubts of many in the value of prolonged courses in practical organic chemistry following strictly defined lines. However, few would wish to dispense entirely with 'textbook preparations' from which students can acquire the elements of manipulative skill without simultaneous demands on their critical abilities, and the present volume provides a valuable compilation of experiments from which selection can be made.

Following sections on basic operations and techniques, including adsorption chromatography, some 70 familiar preparations on the macro scale are described. Typically, a very full description of the procedure to be followed in each preparation is preceded by a concise account of the chemistry of the reaction and its utility, and is followed by supplementary notes on the procedure, test reactions of the product, and a series of questions designed to test the student's understanding of the work he has carried out. Quantities are usually given in moles as well as in grams, and measures to avoid accident are emphasized (although the toxicity of dialkyl sulphates is not mentioned). Preparations are included of aliphatic, aromatic and two heterocyclic compounds, together with experimental work with dyes, sugars, polysaccharides and proteins. Procedures for the resolution of 2-octanol via the brucine salt of the hydrogen phthalate, for azeotropic esterification, and for the chromatographic separation of amino acids on paper, and dyestuffs and leaf pigments on columns, are given. There are a few traditional preparations (such as methane from sodium acetate, and otherwise) which are neither useful nor general. Time schedules in minutes are given for all preparations; a three-hour laboratory period is assumed. Some exercises in the identification of organic compounds are included, and

brief tables of derivatives and their melting points are given for a few classes of compound only.

The volume appears in the soft-cover wire-bound form now familiar for laboratory manuals.

Within its defined field, this book has much to commend it; it is regrettable that its price will inevitably limit its availability to students.

I. T. MILLAR

COSMETIC SCIENCE. Edited by A. W. Middleton. Pp. xv + 327. *London: Butterworths Scientific Publications*, 1959. 60*s*.

This volume contains the 16 papers read at the Congress on Cosmetic Science, arranged by the Society of Cosmetic Chemists of Great Britain in London during April, 1958. This Congress was divided into four sessions, dealing respectively with the analysis of raw materials, the assessment of finished products, manufacturing or processing, and biological analysis. Since only the salient points of each paper were presented at the Congress, there was ample time for discussion of the papers. These, too, are included and, together with the comprehensive index, add greatly to the value of the work.

Many chemists, and certainly the majority of the general public, are unaware of the change now taking place in cosmetic science. This is the transition from empirical formulation to the study of the fundamentals of the subject on a fairly high academic plane. It is apparent in some of the subjects of the papers presented to this Congress, such as product evaluation from the rheological aspect, and the use of ultra-violet spectrophotometry in the examination of essential oils. At the other extreme are papers of a purely practical nature dealing with patch tests, cosmetics allergy, and with heat transfer, corrosion and filtration in manufacturing processes. It is obvious that this book is essential to all interested in cosmetic science.

In the discussions it was suggested that a central research station for the cosmetics industry should investigate matters of common interest to the industry and that an international organization should be formed to correlate the activities of the various national bodies. The former may be difficult to implement but it is an indication of the virility of cosmetic science and a very practical outcome of the Congress that an International Federation has since come into existence.

JULIUS GRANT

BRITISH TECHNICAL EDUCATION. P. F. R. Venables. Pp. 72. *Published for the British Council by Longmans, Green & Co*, 1959. 2*s*. 6*d*. net.

The fifteen sections of this compact book contain an authoritative account of technical education from an author whose name is now well known in educational and industrial spheres. The publication, which is intended primarily to give factual information to students and others overseas, describes the history and structure of technical education in Britain and outlines current developments in this vital branch of education.

Reference is made among many other topics to governance and finance of technical colleges, types of courses in the various colleges, regional examination bodies, professional institutions and to the functions of National and Regional Advisory Councils. Technical Education in Wales, Scotland and Northern Ireland is also surveyed briefly.

Naturally in a book written by Principal Venables there are extensive references to sandwich courses. The author points quite rightly to these courses, and in particular to the encouraging development of courses leading to the Dip. Tech., as the most important recent development in technical education. It is interesting to read also that Dr Venables regards the development of craft and technician courses and qualifications, and the wider recognition of the value of a liberal education as two other significant trends of recent years.

In a concluding section, which in many ways is the most important, the author refers to the vital problem of the supply and training of teachers for technical colleges. He underlines the importance of the recommendations of the Willis Jackson report in this matter and expresses the hope that these will soon be implemented.

D. G. CHISMAN

PUBLICATIONS RECEIVED

ATHLONE FELLOWSHIP NEWS LETTER NO. 4. Pp. 63. *London: Board of Trade*, 1960.

BRITISH COUNCIL ANNUAL REPORT, 1958–59. Pp. vi + 114. *London: The British Council*. 1*s*.

REVIEW OF COAL TAR TECHNOLOGY. January–June, 1959. Vol. XI, Part 1. *Leeds: The Coal Tar Research Association*, 1959. 10*s*.

ANNUAL REPORT OF THE GOVERNMENT CHEMIST, Jamaica. Pp. 9. *Kingston: The Government Printer*, 1959. 2*s*.

REPORT OF THE GOVERNMENT CHEMICAL LABORATORIES, Western Australia. Pp. 15. *Government Printer*, 1959.

MANUAL OF APPROVED FIRMS INSPECTION. Pp. 19. *Ministry of Supply* [*Aviation*] *Inspection Division*, S.P. 22, Feb., 1959.

[During the past three years the Engineering Inspectorate of the Ministry of Supply together with the Chemical Inspectorate have been associated together in an Inspection Division under a Director General. One of the principal objects of the reorganization was to unify the systems of approved inspection. A scheme of approval by the Director General of Inspection has been inaugurated, as described in this manual. The Inspectorates concerned, will, for the time being, be under the Minister of Aviation.]

Institute Affairs

GRADUATE MEMBERSHIP EXAMINATION

PART II

SEPTEMBER, 1960

Theoretical examinations will be held in London, Birmingham and Glasgow, and, if required, in other centres on **Monday and Tuesday, 5 and 6 September, 1960.**

Practical exercises will be carried out in London, Birmingham and Glasgow on **Wednesday to Saturday, 7 to 10 September,** inclusive and in London on **Tuesday to Friday, 13 to 16 September,** inclusive.

Candidates will be asked to state their preference as to the centre for their theoretical papers and the period and centre for their practical exercises; but it must be clearly understood that no guarantee can be given that their wishes will be met.

Candidates who have not yet been accepted for examination and who wish to present themselves in September should obtain from the Assistant Registrar without delay the prescribed Application Form, so as to allow ample time for obtaining the necessary signatures certifying that they have complied with the Regulations concerning their courses of training. **The completed Application Form must reach the Institute not later than Wednesday, 8 June.** No application will be considered if received after that date.

Entry forms will be sent as soon as they are ready to all accepted candidates. **The last date for the receipt of Entry Forms is Monday, 27 June.** No entry will be accepted if received after that date.

MELDOLA MEDAL AWARDS, 1959

The Meldola Medal, which is the gift of the Society of Maccabaeans, is normally awarded annually, the award for a particular year being made to the chemist who, being a British subject and under 30 years of age at 31 December in that year, shows the most promise as indicated by his or her published work. Awards are made by the Council of the Royal Institute of Chemistry, with the concurrence of the Society of Maccabaeans, on the recommendation of a specially appointed advisory committee.

Since the Medal was first instituted in 1921 awards have been made every year, except for the war years 1942-45, inclusive, when they were suspended, and for 1934 and 1958, when it was concluded that no candidate had produced evidence of original work of the exceptional quality required. On the other hand, two awards were made for each of the years 1936, 1946, 1951 and 1952, when there were two candidates adjudged to be of equal merit in diverse fields of work. For the same reason it has been decided to make two awards of the Meldola Medal for 1959. The recipients will be:

JOHN IVAN GEORGE CADOGAN, for his work in the field of organic chemistry, with special reference to reactions of free radicals in solution and to reactions of organophosphorus compounds;

THOMAS CUDWORTH WADDINGTON, for his work in the fields of physical and inorganic chemistry, with special reference to thermochemistry and reactivity of azides; photoconductivity of anthracene; lattice energies and infra-red spectra of inorganic salts; and liquid hydrogen chloride as an ionizing solvent.

J. I. G. CADOGAN was educated at the Grammar School, Swansea, and at King's College, London, where he was placed in the First Class of the B.Sc. (Special) Chemistry degree and was Samuel Smiles Prize winner for 1950 and John Millar Thomson Medallist for 1951. From 1951 to 1954 he carried out research under Professor D. H. Hey, F.R.S., at King's College, where his work involved the quantitative aspects of homolytic substitution reactions of benzene derivatives. Some of the more important advances included the recognition, for the first time, of a steric retardation in these reactions and the discovery of polarized aryl radicals. In 1953 he was awarded a Tutorial Studentship at King's College, and in 1954, after receiving the degree of Ph.D., was appointed first to a Civil Service Commission Junior Research Fellowship and then to a Senior Fellowship tenable at the Chemical Defence Experimental Establishment at Porton, Wiltshire. During this period he became interested in the chemistry of organophosphorus compounds, an interest which he retained on returning to King's College as lecturer in the Department of Chemistry in 1956. Since then he had continued work in organophosphorus chemistry and on reactions of free-radical intermediates.

Dr Cadogan has made a quantitative study of free-radical addition reactions involving bromotrichloromethane and substituted stilbenes. This system has made possible a study of the influence of substituent groups on the direction and relative rates of addition to the double bond, and the effects of solvents on the reaction. With Professor D. H. Hey a study of the decomposition of unusual peroxides has been undertaken with a view to the discovery of new sources of alkyl and aryl radicals. His researches into the chemistry of organophosphorus compounds have been directed to the study of the reactivities of various classes of compound, some of which are physiologically active, towards selected groups of reagents. This work has included the reactions of several types of halogenating and oxidizing agents with phosphorothioates and phosphites, novel rearrangements of piperazinium salts of phosphorothioic acids, the study of the alkylation and dealkylation of phosphorothioates, the rearrangements under heterolytic and homolytic conditions of *N*-halophosphoroamidates, and the study of some free-radical reactions involving trialkyl phosphites.

T. C. WADDINGTON was educated at the Liverpool Institute School, and at Gonville and Caius College, Cambridge, where he obtained first classes in Parts I and II (chemistry) of the Natural Science Tripos. In 1952 he began research under Dr Peter Gray on the thermochemistry, reactivity and structure of the inorganic azides. During the course of this work lattice-energy calculations on the alkali-metal azides were also carried out. He received the Ph.D. degree and was elected to a Fellowship at Gonville and Caius in 1955. In the same year he was awarded a post-doctoral research fellowship at the Laboratories of the National Research Council of Canada, in Ottawa, where he worked with Dr W. G. Schneider on the photoconductivity of organic crystals. He returned to Cambridge in October 1956 to take up his fellowship at Gonville and Caius College and to work in the Inorganic Chemistry Laboratory. In 1957 he was awarded an I.C.I. Fellowship and in 1958 appointed to a University Demonstratorship in Chemistry.

In the field of lattice-energy calculations Dr Waddington has extended the calculations made on the alkali halides and other systems containing spherical ions to systems containing non-spherical ions, such as the alkali-metal azides, bifluorides and cyanates, and has indicated and calculated the additional energy terms. He has also developed expressions for the Madelung constants of distorted lattices.

In the study of the photoconductivity of anthracene he has demonstrated the existence of two types of photocurrent—a bulk current, unaffected by the ambient atmosphere, and a surface photocurrent that is markedly affected by the gases present above the illuminated face.

The infra-red spectra and lattice parameters of the azides, the cyanates and the borohydrides have been investigated, and the relationship of the infra-red spectra and crystal structure of ammonium salts to the occurrence of hydrogen bonding has also been studied.

Current research interests include the study of the anhydrous liquid hydrogen halides as ionizing solvents and as media for preparative inorganic chemistry, the chemistry of iodine–oxygen compounds and of positive iodine, the infra-red spectra of heavy-metal and complex salts, and continued work on lattice energies of inorganic compounds.

Monographs for Teachers.—When the present stocks of Monographs for Teachers, Nos. 1 and 2, are exhausted they will be reprinted with corrections. For the benefit of those readers who have already secured copies, the corrections are listed below.

No. 1. *Principles of Electrolysis* by C. W. Davies.

Page 2, three lines from bottom, 10^{10} should be 10^{9}.

Page 3. The same correction in the formula: 10^{10} should be 10^{9}. In the next line, 10^{-9} should be 10^{-10}.

Page 5. The sentence beginning on line 3 should read: If the column of electrolyte is l cm long and we apply through it an e.m.f. of l volts, the potential gradient will be 1 volt/cm . . .

Page 11. Six lines from the bottom, for p. 16 read page 17.

Page 27. End of penultimate paragraph, for p. 16 read p. 17.

No. 2. *Principles of Oxidation and Reduction* by A. G. Sharpe.

Page 18. On the line after the first centred equation, and again in the last sentence in small type, for M^{n+} read M^{z+}.

Page 22. In the second line, the signs of the two potentials should be reversed, *i.e.* $-0{\cdot}44$ V and $+0{\cdot}76$ V.

No. 3. *Principles of the Extraction of Metals* by D. J. G. Ives.

This monograph was published in April and copies are available from the Institute, price 6*s*.

Approximately double the length of the first two monographs in this series, it contains four main sections—an introductory thermodynamic background, an account of the thermodynamics of pyrometallurgical processes, a discussion of the choice of extraction methods and a description of some typical processes. It concludes with a list of more than 30 significant sources and references.

This monograph, while being written for teachers and advanced students of chemistry, will also be of considerable interest to metallurgists.

Service to Educational Establishments.—A leaflet is being sent with this issue of the *Journal* to all corporate members in the British Isles to obtain information for a survey of the services they are rendering to schools and colleges. It is hoped that all who serve on boards or committees connected with educational establishments will supply the information requested.

Legislation concerning Medicines.—In response to an invitation, the Council has submitted a memorandum to the Interdepartmental Working Party which has been set up by the Minister of Health, in consultation with the Home Secretary and the Secretary of State for Scotland, 'to review the legislative provisions which relate to the control of medicinal substances and to recommend what changes should be made to rationalize and simplify the law with a view to ultimate amendment and consolidation'. In the preparation of this memorandum, in which attention was drawn to issues of special concern to the Institute, the Council had the benefit of the advice of a panel of its members, consisting of Dr Frank Hartley (chairman), Dr D. C. Garratt and Dr F. A. Robinson. It was emphasized that the Institute would wish to concert its views with those of other organizations with related interests before recommendations about changes in legislative provisions were formulated.

PERSONAL NOTES

Honours and Awards

Dr C. F. Cullis, *Fellow*, has been awarded the degree of doctor of science by the University of Oxford for his work on the chemistry of combustion processes and other gaseous reactions.

Professor C. W. Dannatt, *Fellow*, Professor Emeritus of Metallurgy and a former Dean of the Royal School of Mines, has been elected a Fellow of the Imperial College of Science and Technology.

Dr H. J. T. Ellingham, *Fellow*, Secretary and Registrar, was admitted to honorary associateship of the Birmingham College of Advanced Technology, at a ceremony in the Town Hall on 30 April.

Dr R. M. Evans, *Fellow*, has been awarded the degree of doctor of science by the University of London for his work in the field of organic chemistry.

Professor Sir Cyril Hinshelwood, P.R.S., *Nobel Laureate*, *Fellow*, has had the Order of Merit conferred upon him by H.M. The Queen.

Societies and Institutions

Mr J. H. Carrington, *Fellow*, of the Anchor Chemical Co. Ltd, has been awarded the Hancock Medal of the Institution of the Rubber Industry for 1959.

Mr V. Gallafent, *Fellow*, has been elected a vice-president of the Royal Photographic Society of Great Britain.

Mr Harry Ward, *Fellow*, has been appointed special adviser to the British Engineers' Association.

Royal Society.—The following *Fellows* have been admitted to the Fellowship of the Royal Society: Professor J. N. Davidson, department of biochemistry, University of Glasgow; Professor G. Porter, professor of physical chemistry, University of Sheffield; Professor T. R. Seshadri, department of chemistry, University of Delhi; Professor R. L. Wain, department of agricultural chemistry, Wye College, Kent.

Educational

Professor G. M. Badger, *Fellow*, of the University of Adelaide, has been elected Dean of the Faculty of Science for 1960.

Dr J. M. Creeth, *Associate*, has relinquished his appointment at the University of Wisconsin to take up a position in the biophysics division of the Lister Institute of Preventive Medicine.

Dr N. H. Harkare, *Associate*, of the Educational Department, Government of Madhya Pradesh, has been carrying out research at the West Virginia University and is to receive the degree of Ph.D. in chemical engineering this month.

Dr Norman Jackson, *Associate*, has been appointed lecturer in pharmacology at Trinity College, Dublin.

Dr S. Jacobs, *Fellow*, of the National Institute for Medical Research, has been invited to visit University College, Ibadan, to advise on chromatographic techniques applied to protein studies (malnutrition). In June he will proceed to Madrid for the International Congress of Clinical Pathology and will return to London on 18 June.

Mr P. W. Jeffs, *Associate*, has left African Explosives and Chemical Industries Ltd and taken up the post of lecturer in organic chemistry at the University of Natal.

Mr Roy Phillips, *Fellow*, has been appointed Principal of the Yaba Technical Institute, Lagos.

Dr B. S. Thyagarajan, *Associate*, has been appointed Reader in chemistry at the University of Madras.

Dr A. P. Wade, *Associate*, has left the Courtauld Institute of Biochemistry to take up an appointment with the University Endocrine Unit at the Radium Institute, Liverpool.

Dr B. C. L. Weedon, *Fellow*, reader in organic chemistry at the Imperial College of Science and Technology, London, has been appointed to the chair of organic chemistry tenable at Queen Mary College.

Dr T. S. West, *Associate*, *Meldola Medallist*, of the University of Birmingham, has been awarded an Austrian State fellowship and will be on study leave in Vienna for about four months.

Public and Industrial

Mr R. S. Adamson, *Associate*, has taken up an appointment as field experimental officer with Fisons Fertilizers Ltd, Suffolk.

Mr S. E. Blurton, *Associate*, works manager, Imperial Chemical Industries Ltd, Dyestuffs Division, has been appointed divisional works study manager in succession to Mr A. G. Rees, *q.v.*

Mr John Brown, *Associate*, head brewer of Dutton's Blackburn Brewery Ltd since 1942, has been appointed technical adviser to the company. Mr Brown has also been appointed a director of the Crown Brewing Company Ltd and Glasson's Penrith Breweries Ltd.

Mr F. E. Buch, *Associate*, of Mufulira Copper Mines Ltd, S. Rhodesia, has joined the head office organization as vice-president and assistant to the president of the Rhodesian Selection Trust Group of Companies.

Mr S. H. Cakebread, *Fellow*, has taken up an appointment as chief research chemist with Rolls Confectionery Ltd, a division of J. Lyons & Co. Ltd.

Mr P. F. Corbett, *Fellow*, Hon. Treasurer of the London Section, formerly domestic and agricultural manager of the London Division of Shell-Mex and B.P. Ltd, is now fuel oil manager in the same division of the company.

Mr D. R. Fellows, *Associate*, has returned to the Standard Telecommunications Laboratories, Harlow, after spending a year with the sister company in Germany.

Mr E. R. W. Fodgen, *Fellow*, recently took up the post of chief assistant to W. W. Taylor, public analyst and consulting chemist, Nottingham.

Mr J. H. Givens, *Associate*, has been appointed a director of British Celanese Ltd.

Mr C. A. F. Hastilow, C.B.E., *Fellow*, chairman of Docker Bros, is a member of the Industrial Estates Management Corporations for England, Scotland and Wales, set up under the Local Employment Act.

Mr A. E. Heron, *Fellow*, acting section manager of the Analytical Control Section, Research Department, Imperial Chemical Industries Ltd, Billingham Division, has just completed 40 years' service with the company.

Mr J. Howlett, *Fellow*, general manager, chemical division, Distillers Co. Ltd, has been appointed a division director.

Dr J. W. Knight, *Fellow*, technical director of the Geo. Fielder Group, Australia, has been appointed to the Board of Wheat Industries (Australia) Pty Ltd.

Mr F. S. Lomax, *Associate*, has been appointed export director of Beecham Research Laboratories Ltd.

Mr Jasper Mardon, *Fellow*, has relinquished his position as head of the Paper Making Research Group, Anglo Paper Products Ltd, Quebec, to take up an appointment with the Oxford Paper Co., Maine, U.S.A.

Mr A. W. Marsden, *Fellow*, until recently organizing secretary at the secretariat offices of the XV International Dairy Congress in London has left the dairy industry after more than ten years' service to international dairying. He has been appointed organizing secretary of the Second World Congress of Man-Made Fibres to be held in London during 1962.

Miss Mamie Olliver, *Fellow*, lately chief chemist of Chivers & Sons Ltd, has been appointed chief research chemist of the Connaught Food Products Ltd (comprising Chivers & Sons Ltd, Wm P. Hartley Ltd and Wm Moorhouse & Sons Ltd) Section of the Schweppes Research Laboratories, Hendon.

Mr R. W. Peevers, *Associate*, has relinquished his post as works director of British Schering Manufacturing Laboratories to take up an appointment as general factory manager at the 'Ovaltine' Works of A. Wander Ltd at King's Langley. He succeeds Mr J. Young, *q.v.*

Mr A. G. Rees, *Associate*, divisional work study manager, Imperial Chemical Industries Ltd, Dyestuffs and Pharmaceuticals Divisions, has been appointed to the new post of works manager, Burn Hall Works.

Mr Ralph S. Robinson, *Fellow*, has relinquished his position with the Bate Chemical Corporation Ltd, Toronto, to take over the technical responsibilities of Reichhold Chemicals (Canada) Ltd for all their Canadian operations.

Mr D. Shuttleworth, *Fellow*, has left the Distillers Co. Ltd to take up an appointment as technical manager with Maconochie Brothers Ltd.

Mr F. R. Soer, *Associate*, has relinquished his post with the U.K. Atomic Energy Authority at Springfields, to take up an appointment as assistant general manager of Universal-Matthey Products Ltd.

Mr R. N. Wheeler, *Associate*, has been appointed to the staff of the Egham Technical Services Laboratories of Shell Chemical Co. Ltd. He will be particularly responsible for technical liaison with Government departments and official bodies regarding products handled by the company's industrial chemicals division.

Dr W. E. Willmott, *Fellow*, of Damancy & Co. Ltd, Ware, has been appointed to the Board as director of research.

Study Group on Toxic Chemicals in Agriculture.—Dr R. A. E. Galley, *Fellow*, director of the Tropical Products Institute, and Mr C. O. Harvey, *Fellow*, senior principal scientific officer, Department of Government Chemist, have been appointed members of the Research Study Group set up by the Minister of Agriculture, Fisheries and Food, with the Minister for Science, the Secretary of State for Scotland and the Minister of Health, to consider toxic chemicals in agriculture.

Retirements

Mr W. F. Buist, *Fellow*, has retired from his post as lecturer in chemistry at the College of Technology, Art and Commerce, Oxford.

Dr Ernest Chapman, *Associate*, has retired after 35 years in the research department, Imperial Chemical Industries Ltd, Dyestuffs Division.

Mr A. C. Francis, *Fellow*, retired on 5 May from the post of chief analyst of Rowntree & Co. Ltd after 38 years' service. He has been succeeded by Mr A. F. Thompson (*J.*, 146).

Mr G. S. Gowing, *Fellow*, Oil Works Manager, Imperial Chemical Industries Ltd (Billingham Division) retired on 31 March after almost 36 years at Billingham.

Mr P. M. Griffiths, *Fellow*, assistant to the manufacturing director, Shell Chemical Co. Ltd, has retired after more than 32 years' service.

Mr F. J. T. Grigg, *Fellow*, Dominion analyst and director of the Dominion Laboratory, D.S.I.R., New Zealand, retired on 31 March after 42 years' service.

Dr Percy May, *Fellow*, a partner in the firm of Mewburn Ellis & Co. since 1938, has retired but will continue to be associated with the company in a consultative capacity.

Dr R. Rowe, *Associate*, has retired from his post as head of the research and development department of Victor Wolf Ltd, Manchester, but will continue his association with the company in an advisory capacity.

Mr J. Young, *Fellow*, general factory manager at the 'Ovaltine' Works of A. Wander Ltd, has retired after 41 years with the company.

Erratum.—Mr J. McLaren has been appointed head of the chemical engineering department at the Coal Research Establishment, Stoke Orchard, Cheltenham. We regret that this was incorrectly reported last month (*J.*, 146).

FORTY-SECOND CONFERENCE OF LOCAL SECTION HON. SECRETARIES

The Forty-second Conference was held in the Senate Room, Main University Building, The Queen's University, Belfast, at 10 a.m. on Friday, 8 April, the Chair being taken by the President, Mr E. LeQ. Herbert. Professor Harold Burton (Hon. Treasurer; Chairman of the Finance and House, Benevolent Fund, and Education Committees), Dr C. W. Herd (Vice-President; Chairman of the Publications Committee), Dr Norman Booth (Vice-President; Chairman of the Professional Status Committee), and Mr E. J. Vaughan (Chairman of the Membership Committee) were present, and the Administrative Officers were in attendance. The Local Sections were represented by their Hon. Secretaries, except as follows: Aberdeen and North of Scotland, Dr R. H. Thomson (Member of Committee); Birmingham and Midlands, Dr M. Williams (Assistant Hon. Secretary); Cardiff and District, Mr H. K. B. Rout (Chairman); Cumberland and District, Dr F. H. Day (Member of Committee); Dublin and District, Mr H. D. Thornton (Chairman); Hull and District, Dr G. C. Bond (University Representative); Leeds Area, Mr R. K. K. Fourness (Chairman); Mid-Southern Counties, Dr R. E. Parker (District Member of Council); North Lancashire, Mr C. D. Lafferty (Chairman); South Wales, Dr H. E. Hallam (Prospective Hon. Secretary); Thames Valley, Dr A. D. Jenkins (Assistant Hon. Secretary). Owing to local circumstances, the Sheffield, South Yorkshire and North Midlands Section was not represented.

At the beginning of the Meeting, the Chairman referred to the sudden death of Mr E. E. Ayling of Swansea who had greatly looked forward to this Meeting in order to celebrate the completion of 21 years as Hon. Secretary of the South Wales Section. The Conference stood for a minute in silence in memory of a staunch colleague who at all times furthered the interests of the Institute to the utmost of his ability.

Annual Grants to Local Sections. The Edinburgh and East of Scotland Section found it difficult to provide a varied and balanced programme of scientific lectures within its present grant and asked that the basis of the grants might be altered so as to benefit the smaller Sections and those at a considerable distance from the London area. Some other Sections also appeared to meet with the same difficulty. The Hon. Treasurer, in reply, gave reasons for retaining the present system, but reminded Local Sections that special applications could be made for supplementary grants and, for such purposes as those mentioned, would always be sympathetically considered.

Examination Fees and Expenditure. Attention was drawn to the margin between income from Examination and Assessment fees and expenditure on examiners' honoraria, hire of laboratories, and the purchase of apparatus and materials, as shown in the accounts for 1958-59.

The Hon. Treasurer pointed out that substantial expenditure on salaries and overheads was also incurred and said that, in fact, the fees received were barely sufficient to cover the total cost of examinations. He undertook to look into the possibility of illustrating the position more clearly in the accounts for future years.

Standing of Graduate Membership. The Mid-Southern Counties Section asked that steps be taken to ensure proper recognition of the Grad.R.I.C. by the U.K. Atomic Energy Authority. Doubt had arisen in connection with the new 'Scientist' class, where it seemed possible that the Grad.R.I.C would no longer be treated as the equivalent of a good Honours degree. It was reported by the Officers that the specification of acceptable alternative qualifications was still under consideration by the U.K.A.E.A., and that representations would continue to be made.

Service on Science Advisory Committees. The London Section asked for the views and experience of other Sections as to the usefulness and effectiveness of Institute representation on the advisory committees of technical colleges and other bodies with educational functions, such as Regional Advisory Councils. It appeared that some doubted the value of such representation as these Committees were frequently required to deal with matters not strictly or solely connected with education and training in science. The general reaction among the Sections, however, showed that this rather narrow view implied some misapprehension of the purpose of such committees, which by their nature were interested largely in local matters and in everything affecting the welfare of students. In addition, it was good in principle that representatives of a variety of interests should have opportunities to express views on more domestic matters as well as on questions directly related to their special field.

If the Committees were not being used to good effect, it was surely the responsibility of representatives to see that this matter was put right—it was less likely to be rectified if interested bodies were not so represented. Representatives on the governing bodies of colleges were in a somewhat different position and must be prepared to offer advice on a great variety of problems.

Institute Publications. Certain routine matters relating to the preparation of *Journal* reports were discussed. Among recent publications, special mention was made of *Principles of the Extraction of Metals*, by Dr D. J. G. Ives (Monographs for Teachers, No. 3). It was hoped that at least one new monograph, and possibly two, would be added to the series this year, dealing with metallic corrosion and reaction velocity, respectively.

The chief publication now in hand was the *Laboratory Handbook of Toxic Agents*, the production of which had been delayed by the printing dispute last year.

In reply to a question as to whether publications for sale only could be made available to members at a reduced rate, it was pointed out that the saving on Monographs for Teachers would be negligible as they were already sold at as low a figure as possible. It was the intention, however, to allow discount to members on substantial publications being sold to the public through normal trade channels—something in the region of 5*s.* in the £ seemed practicable.

Possible New Grade of Membership. The Conference gave some preliminary attention to the questions raised by the Council statement entitled 'Possible New Grade of Membership and Category of Affiliation' (*J.*, 122), copies of which had been circulated in advance. It was realized that there had not been time to consider the statement fully either in Committee or at Local Section meetings—though it was hoped this would be done—and therefore only personal opinions of the representatives present could be aired at this stage.

The Officers replied to several questions that were raised and discussion ranged over a wide field. It seemed to be widely felt, however, that no matter what had been decided in the past, for the future there was much to be said for providing that anyone who could be called a 'chemist' in the world at large should be able to become attached to the Institute in some grade or category and thus benefit generally by association with the professional organization for chemistry. Many would deplore the creation of another body to cater for the needs of those who were unlikely ever to qualify for admission to the Associateship but who nevertheless possessed recognized qualifications and lived and worked as chemists. The possibility that the creation of such a new grade of membership or category of affiliation might lower the standing of existing grades of membership of the Institute was recognized but was thought no longer to be a serious objection. The effect might even be in the opposite direction. It was thought reasonable that designatory letters should be associated with a new grade of membership that was clearly of good 'pass' degree standard.

The Chairman assured the Conference that the Council did not propose to move hastily in this matter and would decide nothing until there had been ample opportunity for the discussion of the statement by the Local Sections.

At the conclusion of the Meeting, Mr B. M. Dougall, as a son of Antrim, claimed the privilege of thanking the President for having presided at the Meeting and for conducting the proceedings without pressure so that all felt free to express their views without constraint. He added a word of thanks and congratulations to Dr Magee for his part in the arrangements of the Meetings at Belfast.

Afterwards the Local Section representatives attended an informal luncheon in the Great Hall.

Section Activities

BIRMINGHAM AND MIDLANDS

Non-Aqueous Solutions. On 24 February at a joint meeting with local members of the Society for Analytical Chemistry, Professor V. Gutmann of the Technische Hochschule, Vienna, gave a lecture on 'Some Analytical Aspects of Reactions in certain Non-Aqueous Solutions.'

Professor Gutmann dealt with the solubility of a variety of substances in anhydrous halides and oxyhalides, showing that ionic reactions can be followed by conductometric and potentiometric methods, and in many cases also indicators show fairly sharp colour changes. He also described polarographic work in acetic anhydride, ethylene diamine and dimethyl sulphoxide, showing how in these solvents very closely related elements, such as zirconium and hafnium, could be distinguished.

The vote of thanks was proposed by Mr E. G. K. Pritchett, Chairman of the Section.

EAST MIDLANDS

Paint Technology. The first meeting in the new year was held at Derby on 14 January when Mr A. T. S. Rudram gave a lecture on 'Recent Advances in Paint Technology.' The Chairman was Mr G. Oldham, and the vote of thanks was proposed by Mr G. T. Tibbs.

Mr Rudram suggested that the birth of paint technology was itself a recent occurrence historically, for the craft had only in recent times emerged as an industry. He outlined the present state of knowledge about autoxidation processes in vegetable drying oils and illustrated how oil-based films had been modified and developed by polymerization processes.

The electron microscope had been found especially valuable in studies of pigment properties, and the variety of chemical characteristics, sizes and particle shapes of pigments, with which the paint technologist had to deal, were demonstrated.

The speaker then briefly reviewed the newer surface-coating materials, including emulsion polymer systems, organo-metallic systems and chemical-reaction type coatings, in which the film is formed by internal chemical reactions without the introduction of external elements such as oxygen. The talk concluded with some suggestions as to future developments, many of which are already at the pilot usage stage.

Preparation of ^{14}C-Compounds. A joint meeting with the Scientific Society of Leicester College of Art and Technology took place on 18 February. The speaker was Dr J. R. Catch who took as his subject 'Preparation of Carbon-14 Compounds.'

The major use of ^{14}C-labelled compounds today is as tracers in biological research. Their preparation is

conditioned by the necessity of starting from carbon dioxide, the value of the isotope (which is expensive to produce) and the high specific activity commonly required. Radiation syntheses, although interesting, are of little practical value. Chemical synthesis is comparatively efficient and permits good control of the products. Biological approaches have serious limitations but are nevertheless of much value. Some of the practical methods used were shown by means of slides.

After an interesting discussion the vote of thanks was proposed by Dr R. W. C. Broadbank.

Electrophilic Substitution. A joint meeting with the Chemical Society, and the Chemical Society of Nottingham University was held at the University on 23 February to hear Professor Sir Christopher Ingold, F.R.S., discuss 'Developments in the study of Electrophilic Substitution.' The University Society were hosts for the meeting and the Chair was taken by Professor A. W. Johnson.

Professor Ingold divided his lecture broadly into three related sections—nitration, nitrosation, and a comparison of these as contrasting types of electrophilic substitution. He described the ways in which kinetic studies played a large part in elucidating the reaction mechanisms in each case. Dealing first with nitration, he showed that the various combinations of the nitronium ion with Lewis bases ($NO_2.OH_3^+$, $NO_2.Cl$, NO_2NO_2, $NO_2.NO_2$, and $NO_2.OH$) were effective only in so far as they produced the NO_2^+ ion and that this latter was the actual nitrating agent. The development of the argument included an account of the findings of Bunton, Halevi and Llewellyn on the nitration of ^{18}O-labelled water. This work further supported the unimolecular nucleophilic substitution (S_N1) mechanism of nitration, when what was being nitrated was regarded as the substituting agent.

Next came nitrosation and in particular the work of Hughes and Ridd on diazotization, which is rate-controlled by nitrosation. In this case, the nitrosating agent is not the NO^+ ion, but the Lewis-base compounds of this ion, such as $NO.OH_2^+$, NOBr, $NO.NO_3$, $NO.NO_2$, NO.OAc, NO.OH. Nitrosation, in fact, follows the bimolecular nucleophilic substitution (S_N2) mechanism, regarding what is nitrosated as the substituting agent. Professor Ingold then described the difficult problem of elucidating some of the mechanisms of diazotization reactions. Proceeding from a statement of ten possible mechanisms, he showed how kinetic studies revealed that in general the nitrosating agent is N_2O_3, with second- or third-order kinetics, depending on the acidity of the medium. But this is not the complete picture. Anion-catalysed diazotization reactions, for example by way of formed NOBr, indicate a third-order mechanism involving the $H_2NO_2^+$ ion as the effective reagent; in fact, as Professor Ingold remarked, nitrous acid is about the only nitroso-compound which does not nitrosate directly. The lecture concluded with a review of the various established mechanisms of aqueous diazotization, and Lidstone's contribution to explain in simple terms the S_N2 reciprocal interconversions of nitrosating species, which nitrosate each other unless given something else to nitrosate similarly.

After a short discussion, the vote of thanks was proposed by Professor D. D. Eley, who commented on the important role played by physical chemistry in the study of organic reaction mechanisms.

HUDDERSFIELD

Visit to Elland Power Station. On the evening of 16 February, several members visited the power station at Lowfields, Elland. Senior members of the power-station staff acted as guides on a two-hour tour of the generating plant, one of the most modern of the conventional type in the country. After the tour, the visitors inspected the control laboratory, which contained several items of apparatus of special interest. Dr E. Tittensor, Chairman of the Section, thanked the Station Superintendent and his staff for the kindness and courtesy shown to the visitors.

LONDON

Ion-Exchange Membranes and their Applications. A joint meeting with the College Chemical Society was held at Battersea College of Technology on 2 December. Mr P. A. Raine was in the Chair and Dr H. T. Hookway spoke on 'Ion-Exchange Membranes and their Applications.'

Dr Hookway began by describing the properties of granular ion-exchange resins which are water-swollen polyelectrolyte gels containing ionic groups. These groups may be basic, acidic or chelating.

Membranes, which are ion-exchange resins in sheet form, found few applications at first because the early types were of poor chemical stability and high electrical resistance but modern methods of formation have overcome these difficulties. Membranes containing strongly acidic or basic groups are of more interest since they are almost completely ionized under normal working conditions.

The membranes function by virtue of the Gibbs–Donnan membrane equilibrium, the high concentration of fixed ionic groups serving to exclude diffusible ions of the same charge. Because of this property it is found that when an electric current is passed through a cation exchange membrane, virtually the whole of the current is carried by the mobile cations, and most applications depend on the simple property of selective ion transport.

A membrane containing a high concentration of fixed ionic groups is required for all but the most dilute electrolyte solutions. Concentrations of fixed ionic groups of 4–5 M can be attained fairly easily and such membranes can be used with electrolyte solutions up

to about 2 M, but beyond this ionic selectivity begins to drop rapidly.

For practical applications the transport number of the mobile ion in the membrane should be close to unity, and the water transport, which always accompanies ion transport, should be as low as possible. A typical cation exchange membrane will have a transport number of 0·9 or better.

Ion-exchange membranes are of three types. *Heterogeneous* membranes made by mixing the finely ground resin with an inert binder, such as polythene or PVC. These films have poor mechanical qualities and high water transport. *Interpolymer* membranes are made by casting a film from a solution of ion-exchange resin in a water-insoluble film-forming material. *Homogeneous* membranes are in theory the best systems in which the film-forming resin itself carried the ionic groups. Examples of these are made by condensing phenolsulphonic acid with phenol and formaldehyde, or by copolymerization of styrenesulphonic acid with styrene and divinylbenzene.

Dr Hookway concluded by discussing some applications of these membranes. Many of these are conducted in three-compartment cells in which membranes prevent reaction products round the electrodes from mixing. A major application of this type is in the desalting of water when salt is progressively removed from the central compartment. Greater efficiency is obtained by the use of multi-compartment systems. Other applications mentioned were in demineralizing glycerol, sucrose and gelatin solutions, the recovery of iron and sulphuric acid from pickle liquor and the production of caustic soda free from sodium chloride.

A vigorous discussion took place and the vote of thanks proposed by Mr Whymen was carried enthusiastically.

Incorporation of Metals in Refractories. A joint meeting with local members of the Society of Chemical Industry was held at 14, Belgrave Square on 4 January. Mr E. G. Peppiatt took the Chair and Dr T. H. Blakeley and Mr A. E. S. White read a joint paper.

Dr Blakeley began the lecture by reviewing the properties of refractories in comparison with metals. In general, refractories have better strength and stability at high temperatures (say 1,000° C and over) but are inferior to metals in impact strength and thermal shock resistance. Dr Blakeley gave an equation showing that thermal expansion and Young's Modulus should be low, and tensile strength and thermal conductivity high if the properties were to be improved.

Mr White then discussed the possibility of effecting this by incorporating metals in a refractory. The best structure was thought to be one in which both metal and ceramic were interlocking matrices. He then discussed the matching of thermal expansion and sintering temperatures and methods of obtaining good wetting between the metal and ceramic, together with methods of manufacture. It was concluded that the nickel–magnesia system fitted most of the desirable criteria, and work was described on bodies made by powder metallurgical methods.

Small additions of nickel to magnesia had little effect on strength but increased thermal shock resistance and reduced thermal conductivity. The improved thermal shock resistance was probably due to a texture effect. Greater additions of nickel increased both thermal shock resistance and thermal conductivity. Hot strength tended to rise slightly, but then fell rapidly at over 80 per cent nickel addition. An optimum addition was 75 per cent nickel by weight, combining good hot strength and thermal shock resistance. In general, the formula for thermal shock resistance given earlier agreed well with practice.

Mr F. C. Hymas proposed the vote of thanks.

Recent Advances in Glass Technology. A meeting was held at Enfield Technical College on 18 January. Mr A. J. Turnbull was in the Chair and introduced the speaker, Dr D. K. Hill, Deputy Director of the British Glass Industry Research Association.

Dr Hill began by saying that the glass industry is a basic one, divided into six main sections: containers, the largest section; flat glass; specialized, *e.g.* electrical, electronic, optical; domestic glassware; chemical glassware; glass fibres.

Systematic research began in 1915 in the University of Sheffield, but by 1940 about a hundred academic institutions were engaged in it. Today every sizeable glass firm carries out some research. In the United Kingdom there are two centres in Sheffield—the University Department of Glass Technology (fundamental research and teaching) and the Glass Industry Research Association (fundamental and applied research).

Dr Hill produced a sample tonic-water bottle made in the 1930s, and explained that today a similar bottle would have less than half the weight, be three to four times as strong and withstand 250–300 lb/in^2. The improvement was due to better knowledge of glass structure, mixing and choice of raw materials, control of melting, forming machinery, packing, transport, handling and design.

The nature of glass was not yet fully understood. X-ray analysis had suggested that silicon atoms in glass might be present in a random network linked by oxygen atoms, and that the randomness could be varied, and with it the structure of the glass.

Glasses could be formed not only from oxides, but also from sulphides, chlorides and the like. Dr Hill gave a list of bond-strengths with oxygen for a number of elements and said that the elements with highest bond-strength could, with oxygen, form continuous networks. Alkalis were introduced into glass to alter the physical properties.

Dr Hill then described the basic manufacturing processes. Today glass is made by a continuous process in large furnaces with an average charge of about 250 tons, and a maximum of about 2,000 tons.

Flat glass used to be made by first forming cylinders, which were then cut into three and flattened in a furnace. In one modern continuous process both faces are ground and polished simultaneously.

In reply to questions after his talk, Dr Hill said that no evidence of crystallization had been found in old glasses, and he described also the principles of manufacturing toughened glass, and the float process for plate glass.

Non-aqueous solvent systems. A joint meeting was held at Slough College of Further Education on 27 January. The Principal, Dr B. W. V. Hawes, welcomed members of the Section, and introduced Mr P. A. Raine, Chairman for the meeting. The Chairman then introduced the lecturer, Dr C. C. Addison.

Dr Addison gave a brief account of early concepts of acids and bases, and outlined the significance of self-ionization, *e.g.*

$$NH_3 \rightleftharpoons H^+ + NH_2^- \qquad 2SO_2 \rightleftharpoons SO^{2+} + SO_3^{2-}$$

in the work on liquid ammonia and liquid sulphur dioxide carried out by Franklin and Walden in the years immediately after 1900.

The use of non-aqueous solvents has led to methods for the preparation of new compounds. Thus many new fluoro-complexes have been prepared in liquid bromine trifluoride, the reactions involved being based on the ionization: $2BrF_3 \rightleftharpoons BrF_2^+ + BrF_4^-$. Dr Addison emphasized that the properties of the pure liquids must not be confused with those of the aqueous solutions. This was illustrated by reference to solutions of proteins in anhydrous hydrofluoric acid. A second advantage in the use of non-aqueous solvents is that compounds known only as hydrates (such as metal nitrates) can be prepared in anhydrous form, when their properties may differ considerably from those of the hydrated compounds.

The lecturer then discussed the effect of various media on the preparation of silane. Although solvolysis reduces yields in water or liquid ammonia, the reactions $LiAlH_4 + SiCl_4$ in anhydrous ether, or $LiH + SiCl_4$ in molten KCl/LiCl, give 100 per cent yields of silane. Solvents chosen should be appropriate to the reaction, *i.e.* HF or H_2SO_4 for dehydration and proton donation; BrF_3 for metal fluorides and fluoro-complexes; SO_2 for reactions involving thionyl or sulphuryl groups; liquid NH_3 for nitrogen–hydrogen compounds and N_2O_4 for nitrogen-oxygen compounds. The important physical properties of solvents were outlined as a guide to solvent preference.

The lecturer went on to discuss unusual solvent properties of some liquids, of which the solutions of alkali metals in liquid ammonia, in certain ethers and in molten salts are typical. He considered recent examples of the reducing properties of these solutions, *e.g.* towards metal carbonyls and their hydrocarbon derivatives, and directed attention towards the interesting observations by Zintl that liquid ammonia containing sodium will dissolve metals (*e.g.* Pb, Bi, Sb) to give soluble compounds (*e.g.* Na_4Pb_9).

Molten salts represent the largest class of non-aqueous solvents, and this field is relatively undeveloped so far as inorganic reactions are concerned. With solutes of variable valency (*e.g.* uranium compounds) reduction is possible in halide melts but not in nitrate melts. Molten salts also dissolve metals to a high degree. These solutions are important in relation to extraction and isotope enrichment processes involving liquid metal–molten salt systems.

Most of the traditional low-temperature solvents have been used in pure form. The lecturer outlined certain advantages, particularly in synthetic inorganic work, to be derived from the use of mixed solvents. Liquid N_2O_4 possesses very limited self-ionization, and is not reactive towards many metals. This activity can be stimulated by the addition of electron-donor solvents such as esters, ketones and nitriles. Dr Addison gave examples from work in progress in his laboratory. Reaction with copper metal gave the compound $Cu(NO_3)_2.N_2O_4$, which on heating in vacuum gave a volatile anhydrous blue copper nitrate. The volatile ferric compound $Fe(NO_3)_3.N_2O_4$ has been prepared in a similar manner.

The lecture, which it is proposed to publish in full, was illustrated with numerous slides.

A lively discussion followed and included questions on the degradation of copper in oils, Zintl reactions, separation of proteins, separation of TiO_2 from the ore and nitrile bonding.

Mr Rees-Jones, Secretary of the College Chemical Society, proposed the vote of thanks.

Reaction Mechanisms. A joint meeting with the Sir John Cass Student Chemical Society was held on 8 February. The chairman for the meeting, Mr G. C. Ackroyd, introduced Professor E. D. Hughes, F.R.S., who gave a characteristically clear discussion of this subject. The substance of the lecture was very similar to that already reported (*J.*, 1959, 326).

The vote of thanks, proposed by Mr Powell, was carried enthusiastically.

Cementing Action. A meeting was held at the N.W. Kent College of Technology, Dartford, on 11 February, under the Chairmanship of Mr F. C. Hymas, when Professor J. D. Bernal, F.R.S., gave a lecture entitled 'Principles of Cementing Action.'

Professor Bernal began his lecture by defining cementing action. This property can be displayed by both inorganic and organic materials, *e.g.* silicate cements;

plasters based on lime, calcium sulphate or magnesium salts; animal glues and synthetic adhesives.

All must follow the same pattern of (i) adhesion, (ii) setting, followed by (iii) hardening. The time scales might vary from seconds to hours for (ii) and from hours to years for (iii).

The lecturer then went on to explain how the cementing action was brought about by rapid crystallization. This yielded elongated or dendritic crystals which interlock and bond together.

Confining his further remarks to the cementing agents found in Portland Cement, Professor Bernal paid tribute especially to Jeffery and Taylor who had carried out a great deal of work on the hydration of Portland cement. This cement is composed mainly of tricalcium silicate, dicalcium silicate and a glassy phase containing aluminates and aluminoferrites. The tri-calcium silicate (known to cement chemists as 'C_3S' or alite) is the main cementing agent present. On hydration a calcium silicate hydrate is found but Jeffery and Taylor had found little difference between the X-ray crystallographs of fresh Portland cement clinker and a hydrated one. This indicated that only a small amount of the alite hydrated, and this could be confirmed by grinding the set cement to a powder and adding more water. Further hydration and setting would then be observed.

In order to determine the structure of the hydration products a study was made of naturally occurring hydrated calcium silicate minerals which yield larger crystals than samples of the corresponding synthetically prepared compounds. Of these natural minerals, Riversideite or Tobermorite show patterns very similar to the synthetic calcium silicate monohydrate. All are chains of fibrous nature with three–O–SiO_2– in the repeat unit. This treble unit repeats in about 3·65 Å, which is large enough to accept the calcium atom, in contrast to the double unit found in the paroxene metal silicates, which is large enough to accommodate the smaller Mg and Fe ions. On heating, the calcium silicate hydrates go through a number of phases preserving the fibrous structure and emerge as Wollastonite $(CaSiO_3)_x$.

Complementary work on the sodium metaphosphates (analogues of the silicates) carried out in Germany has indicated essentially similar structures.

In water, tricalcium silicate first produces a solution of calcium and silicate ions supersaturated with respect to $CaSiO_3.H_2O$, which therefore first crystallizes. The reaction is slow and appears to form a self-protecting hydrate layer which prevents further action. Ultrasonic vibrations disrupt this skin but also break up the interlocking crystallites, and no strength is developed. If it were possible to continue the hydration while still retaining strength development less cement would be needed in a given mix.

Professor Bernal concluded by mentioning the natural cementing action which occurs during the formation of geological strata of sedimentary origin. He described some experiments on hydrothermal crystallization which would yield more information about cementing action.

The vote of thanks was proposed by Mr A. H. Thorneloe.

Rocket Propellants. A meeting was held on 17 February at King's College when the Chairman was Mr F. C. Hymas and the speaker was Dr W. G. S. Parker.

Dr Parker began by pointing out that propellants depend on the production by a controlled reaction of gas at high temperature and pressure. Their performance is assessed by their specific impulse (I) which largely depends on $(T_c/\overline{M})^{1/2}$, where T_c is the combustion gas temperature and $\overline{M}$ is the mean molecular weight of the combustion gases.

A review of chemical systems shows that the best are oxidation reactions involving oxygen or fluorine with the light elements (hydrogen, lithium, beryllium and boron) or with compounds of the light elements and hydrogen. The value of the light elements (except hydrogen) as fuels is limited by the high enthalpy of vaporization of the oxides.

Liquid oxygen with a hydrocarbon fuel is the most widely used liquid propellant system. The specific impulse of this system for a given set of conditions is 286 seconds, and that for hydrogen and oxygen under the same conditions is 388 seconds. The best performance so far known for stable chemicals is 400 seconds for liquid hydrogen with liquid fluorine. Only systems involving liquid ozone or high concentrations of free radicals would be more effective, and the problems of dealing with ozone in bulk and producing free radicals in usable concentrations have not been solved.

Liquid oxygen, hydrogen and fluorine all require low-temperature installations. Fluorine is also very toxic and corrosive, and cannot be used as a coolant for the walls of the combustion chamber. Hydrogen peroxide and red fuming nitric acid are easier to handle but do not give quite such a good performance as liquid oxygen. Hydrogen peroxide may also be used as a monopropellant by bringing about rapid decomposition on a catalyst such as silver. The mechanism of this catalysis is an interesting problem which has been studied recently.

Solid propellants are simpler for use in rockets, which then have fewer mechanical parts and are rather more reliable. Their performance is lower, however, the specific impulse being in the range 180–240 seconds. It is unlikely that solid propellants will ever equal the best liquid propellants because they are closely related to explosives, and a major limitation to their development is the need to avoid compositions that detonate.

Solid propellants can be divided into two main types. The double base type, to which cordite belongs, is a mixture of nitrocellulose with another nitric ester, such

as nitroglycerine. A stabilizer and other ingredients, including metal powders, are incorporated to modify ballistic and energy properties.

The second type, composite propellants, have been developed from pressed charges like black powder to mixtures containing an oxidizer, usually ammonium perchlorate or nitrate and a rubbery or plastic material which acts as a binder and fuel.

Finally Dr Parker discussed the processes occurring in combustion chambers and demonstrated diffusion flames of ammonia with oxygen, ethylene with oxygen, and hydrogen with chlorine on a novel burner designed to permit spectroscopic analysis of the flame.

Dr S. A. Miller proposed the vote of thanks.

Film Show. A film show took place on 23 February at Norwood Technical College. Members and visitors were welcomed by Mr M. A. Fill, Acting Head of the Chemistry and Biology Department, who introduced the Chairman for the evening, Mr P. A. Raine.

The following films were shown: 'Crystallization,' 'Healing Rays,' 'Quick Freeze' and 'Engineering at Calder Hall.' At the end of the programme votes of thanks were proposed by Mr S. Stevens, Vice-Chairman of the Governors, to the Section for providing the films and to the Principal and Mr Fill for arranging the facilities.

MANCHESTER AND DISTRICT

Radiation Chemistry of Organic Substances. On 22 February at the College of Further Education, Stockport, Professor F. S. Dainton, F.R.S., gave a lecture on organic radiation chemistry. He said that the atomic energy industry was now producing large amounts of radioactive by-products and any researches that resulted in an outlet for these materials would be of great value both to the chemical industry and in reducing the cost of atomic power.

Professor Dainton described the effect on the valency electrons caused by the passage of a radioactive particle through the material. For instance, as an α-particle approaches a molecule of the material, the valency electrons are subject to a force in the direction of the alpha particle. The component of this force, perpendicular to the path of the alpha particle, increases to a maximum, as the particle approaches the molecule. As the α-particle recedes from the molecule this force then decreases. If the molecule is some distance from the path of the α-particle then the result is energy oscillations within the molecule, that is, the molecule is said to be excited. When the molecule is much nearer the path of the α-particle the attractive forces are sufficient to remove an electron, thereby forming a positive ion. Once the electron has been removed the chances of its coming again within the vicinity of a positive ion are quite small and thus the life of the ions is relatively large. The excited molecules or the positive ions are the starting points of a series of chain reactions. Professor Dainton considered the energy transferred from the bombarding particle and described typical products from reactions of this type.

The lecture was interspersed with humorous references and was so delivered as to be interesting to those who had little prior knowledge of the subject. Dr S. J. Fletcher proposed the vote of thanks.

Symposium on Chemical Product Development. An annual event in the Section's programme, the joint symposium with the Society of Chemical Industry, took place in the University on 17 February and was this year organized by the Section. In his introductory remarks the Chairman, Dr L. R. Ridgway, explained that the lectures would cover three main topics: the economics of research and development, the actual development programme and the marketing of a typical development product.

Professor B. R. Williams (University College, N. Staffordshire) began his lecture on 'The Economics of Product and Process Development' by reviewing the national expenditure on research and development over the past 30 years. This doubled between 1931 and 1938 and doubled again over the period 1938–50. The

Mr J. Willock, Dr L. R. Ridgway, chairman, Professor B. R. Williams and Dr E. Hoggarth at the Symposium.

expenditure at the present time is again almost double that in 1950. The D.S.I.R. estimated that direct expenditure on research and development was about £300 million in 1956 or 1·8 per cent of the gross national product. Professor Williams estimated that the corresponding figure for 1959 was about £445 million, or 2·1 per cent. As prices have gone up by 15 per cent over the years 1955–59, the increase in expenditure in real terms is about 30 per cent over these years. Private industry finances half of this expenditure compared with only a quarter three years ago. There has been a big increase in scientific manpower since 1956 and this means that the amount spent by private industry on research does not have to be held back. It is interesting to compare the British effort with that of

the United States of America. Relative to the gross national product the amount spent is similar but it is important to realize that, *per capita*, the gross national product of the United States is double that of Britain, and population three times greater. Professor Williams then dealt with the economics of research and development as it applies to individual firms. He recommended that a cost survey should be carried out at least once every year and only the promising projects should be continued. The projects should be categorized as follows: (i) research completed and the development of the production process in hand; (ii) preliminary research carried out sufficient to assess possible market outlet; and (iii) initiation of new researches leading to completely new fields of operation. Each project would fall into one of the above categories and should be considered with regard to time, cost, financial potential, manpower available and, most important, implied investment and yield on capital.

Finally Professor Williams explained how the research of an individual organization affects the country as a whole. Collective action is essential as often costly projects have low priority for a single firm but are worthwhile from the standpoint of industry as a whole. As yet we are not in a position to answer the question of how much should be spent by the country on research and development.

Dr E. Hoggarth (I.C.I., Ltd) then spoke on 'New Product Development and Fine Chemicals' and in his introduction said that he would limit his lecture to the batch-wise production of fine chemicals, such as medicinals. The development of the product was considered in two main phases. The initial stage is the production of the article using existing units and equipment. At a later stage a more sophisticated process is designed to form the final manufacturing route.

The starting point of the first stage is usually a laboratory recipe and a description of quality. The development laboratory investigates practical reactions and resulting yields. At the same time some data are obtained on the tolerances of processes to deviations from optimum conditions. Control tests to ensure reproducibility are also necessary. Data on corrosion, safety precautions and costing should be tabulated. The amount of work to be done at this stage must be a matter of judgment but in general it should be sufficient to consider the advisability of proceeding.

Tentative plant processes are now put into operation. Generally, lower yields and a poorer quality are obtained than in the laboratory. These are the result of difficulties associated with increasing the scale of the process. In particular, it is difficult to carry out such manipulations as filtering, washing and separation as effectively on the plant scale as in the laboratory. This preliminary plant exercise will often provide sufficient product for the future customers' reaction to be obtained, and this gives a second opportunity of reconsidering the advisability of proceeding. More work must now be carried out in the laboratory as a result of information obtained during the first plant trials. This work is directed at bridging the gap between laboratory and plant yields, solving quality problems and reducing costs.

At this point a re-statement of tolerances and control tests is often advisable. Information from the laboratory is then used in a modified process to provide a continual supply of the product until superseded by the carefully-designed final manufacturing route. The aim of the final manufacturing route is to reduce costs and to improve quality, and is often connected with an increase in output. A critical appraisal of the work already done is essential and this includes realistic cost estimates and whether or not to employ the process already being worked. The first manufacturing route was based on intuition and availability of equipment, but this final phase involves more fundamental thinking. Further results will be required from the laboratories whose work will be directed at attempts to increase yields and quality, and the use of less expensive raw materials and solvents. This phase should lead to a conception of the final plant, and early collaboration with specialist engineers is essential. The manufacture will be able to proceed after final trials have been made with the completed new plant.

Mr J. Willock (Courtauld's Ltd) then gave an entertaining lecture on 'Marketing Man-Made Fibres.' In his historical review he emphasized that the viscose process was brought to fruition by people in textiles and that the development of the acetate process resulted from the need to find markets after the first world war. These early pioneers bought mills and dye-works and produced the finished article. There was a build-up of production after the war followed by a recession resulting in the emergence of many new fibres and the intense competition which led to the concept of marketing as it is today. Mr Willock described the five prongs of marketing as development, market-research, direct sales, technical services and merchandizing, and reviewed the functions of each. The development section covers a large field. It has to evaluate the yarns and fabrics, consider new end-uses and carry out trials of spinning, weaving, knitting, dyeing and so on. The technologists and statisticians employed in market research produce long- and short-term forecasts and analyse sales reports. The direct sales division, together with area representatives, must control the planning for production and be responsible for the allocation of new products to the markets. The technical service section includes technologists who visit users every week and whose responsibility includes the introduction of new lines and the investigation of compounds. The responsibility of the merchandizing section includes wholesale and retail contacts, advertising, publications and exhibitions.

The introduction of a new fabric may need the resources of a large team, or a small team of one or two people. Mr Willock gave as examples of this the introduction of crimped and bulked nylon, and of polythene for fishing nets. Finally he described the marketing of Tricel and showed a film.

Dr G. A. Gamlen proposed the vote of thanks to the three lecturers.

MID-SOUTHERN COUNTIES

Living Material as a Factory. On 26 February a meeting was held jointly with the Poole and District Technical Group at Poole Generating Station. The lecturer, Dr C. W. Parr, of the Department of Biochemistry at the London Hospital Medical College, spoke on 'Living Material as a Factory.'

The lecturer began by outlining the way in which plants and animals store energy in chemical form and how they 'process' such stores inside the cells.

The substance most frequently involved in the biochemical use of energy is adenosine triphosphate (ATP). An unusually large amount of free energy, about 8 kcal/mole, is released on hydrolysis of ATP to adenosine diphosphate (ADP) and inorganic phosphate. Another example of an energy-rich phosphate compound is phosphoenolpyruvate, which would liberate about 12 kcal/mole of free energy, largely as heat, if its phosphate group were hydrolysed. But in biological systems the phosphate is often 'transferred' rather than hydrolysed, thereby conserving a considerable proportion of the energy. Thus, phosphoenolpyruvate will react with ADP, in the presence of the appropriate enzyme, to form ATP and pyruvate.

Dr Parr then traced the metabolism of glucose, a universal foodstuff for living organisms. Many intermediates arise before the end-products, carbon dioxide and water, are formed. At a number of points an oxidative reaction occurs, actually by a process of dehydrogenation, and such steps involve a free-energy change of about 50 kcal. Associated with each of these oxidative steps, and by means of energy-rich phosphate compounds not yet identified, three molecules of ATP are synthesized from ADP, thus 'trapping' some 50 per cent of the released free energy as chemical energy. Such oxidative steps do not normally take place unless ADP is available; oxidation is coupled with phosphorylation.

In the muscles of animals the protein actinomyosin, which comprises muscle tissue, is thought to be activated and so to act as an enzyme, hydrolysing ATP to ADP and inorganic phosphate at the moment of muscular contraction; thus there is direct conversion of the energy-rich-phosphate energy of ATP into mechanical energy.

The lecturer said that in metabolism ATP is sometimes synthesized and sometimes used to 'drive' a reaction. It is implicated in such diverse processes as the generation of light energy in the glow worm and of electricity in the electric eel.

Dr Parr then dealt with cell structure and cell functions. He discussed the evidence of the electron microscopists for the existence in the cell cytoplasm of a network of interconnected channels known as the endoplasmic reticulum, and of the complex structural system inside the mitochondria, the small bodies in the cytoplasm in which oxidative processes and the generation of ATP seem to be largely confined.

A high degree of organization is revealed in the structural detail of the cell and in the arrangement of metabolic sequences. Control mechanisms clearly exist for regulating metabolism, and an example is the close coupling of oxidation to phosphorylation, so that oxidation increases only as the need for ATP increases. But there lies revealed a very complex system, and the biochemist, as yet, can indicate only in the most general terms how cell metabolism is regulated.

TEES-SIDE

Development and Uses of the Patent System. On 20 January a meeting was held in Norton when Mr R. T. Swarbrick gave a lecture on 'The Development and Uses of the Patent System.'

Mr Swarbrick said that patents may be regarded as documents which record the grant of a privilege by the Crown. The term 'Letters Patent,' coming from the Latin meaning 'open letters,' is used to describe a document sealed so that it can be read without breaking the seal. Patents in Britain were first used in the 15th or 16th century as a custom instituted by the reigning monarchs to supplement their incomes by the grant of monopolies in trades and commodities. This finally resulted in the Statute of Monopolies in 1624 which abolished all monopolies except for Letters Patent for inventions. This was to stimulate industry and trade. The modern patents are based on Acts of 1883 and 1946. A patent today gives an inventor a monopoly in his invention for a limited period in return for publicly disclosing his invention. A provisional specification describing general aspects of the invention is filed, and it has to be completed in 12 months, when it is open for public inspection. Three months are allowed at this stage to oppose the grant of a patent. If there is no opposition the patent is granted by sealing.

In 1919 the Patent Act was amended to exclude the patenting of chemical substances *per se*, so that only processes could be patented. This limitation was removed by the 1946 Act. Naturally it is open for others to invent and patent new methods for producing a patented compound, but suitable arrangement with the owners of the substance patent must be made before the new route can be worked.

The lecturer described the complexities which arise in patent law, and how it varies from one country to another.

A New Acetal Resin. A joint meeting with local members of the Society of Chemical Industry was held on 5 February at Middlesbrough, when Dr G. F. C. Barrett gave a lecture on 'Delrin', a new acetal resin.

Dr Barrett said that formaldehyde polymers had been known for over a century and their structure was shown in 1920 to consist of polyoxymethylene chains. These polymers were insoluble in most solvents and were thermally unstable. The advances made in recent years had shown that pure formaldehyde could be polymerized with acids under carefully controlled conditions in solution to give a polymer in a restricted molecular-weight range and with a greater thermal stability. The thermal stability could be further improved by esterification of the terminal hydroxyl groups. Polymers prepared by these methods were highly crystalline and were marketed under the name 'Delrin.'

The physical properties of these new acetal resins were described in some detail and compared with other plastic materials. The lecturer considered that the new plastic would go some way to replacing metals and showed several examples of moulded gear wheels, handles and the like.

THAMES VALLEY

Evening Symposium. The Section held an Evening Symposium of short papers by younger members of the Section at the University of Reading on 25 February. Dr S. G. Perry of Esso Research Ltd, gave a lucid account of the analysis of hydrocarbons in the C_1–C_5 range by gas chromatography. Mr G. Moss of the Radley Industrial Research and Development Laboratories then gave a description of his work on the inhibition of the corrosion of copper by ammonia in the presence of sugars and related compounds under the title of 'Fortuitous corrosion inhibition in biscuit mixes.' The subject of the next speaker, Mr I. H. Bath of the N.I.R.D., Shinfield, was 'Carbohydrates of herbage and their utilization by the dairy cow'; he gave an interesting account of the analytical techniques used in this type of work and of the application of the results to the study of the interior economy of the cow. The final paper, by Mr C. McRae of the University of Reading on 'An application of nitrogen-15 to the study of organic reactions' sustained the interest of the audience to the end. A number of questions were asked at the end of his paper. Dr D. T. Lewis, Chairman, made short speeches of thanks to the speakers.

EAST AFRICA

Fifth Annual Conference. The Fifth Annual Conference took place at Nakuru, Kenya, on 14–15 January.

Although only two members of the Section live in Nakuru, nineteen members together with a number of their wives and other visitors assembled for the Conference, some having travelled several hundred miles. Both Kenya and Uganda were well represented but unfortunately the only delegate from Tanganyika had to withdraw at the last minute owing to illness.

The Conference was officially opened by Mr D. H. Pell-Smith, Chairman of the Pyrethrum Board, in whose premises the meetings were held. Welcoming members to Nakuru, Mr Pell-Smith said how gratified he was that this conference should be held under the wing of Pyrethrum Board of Kenya. The chemist was vitally concerned in this industry from the point of view of both agricultural development and insecticide research. The isolation of many workers in areas such as East Africa made it particularly valuable that chemists should come together to share their interests and experience and to learn of some of the advances being made in their subject. Mr Pell-Smith hoped that the Conference would be enjoyable as well as instructive and that the choice of Nakuru as a centre would be fully justified.

Professor M. Crawford, Chairman of the Section, thanked Mr Pell-Smith for the generous hospitality of the Pyrethrum Board, and went on to speak of the scientific developments taking place in East Africa. It was evident there would be a growing need for qualified chemists and that every effort should be made to use the small numbers available to the best advantage. Of particular interest was the proposed setting up of the University of East Africa. Academic developments would also include the provision of special honours courses in chemistry so that chemists of full professional standard could be trained.

The Conference programme included three lectures and a discussion on 'The Training of Chemists and Chemical Assistants.' During the past year sub-committees in Kenya and Uganda had been considering the needs and opportunities for training, and brief reports were made to the Conference. It was evident that the problem was complex and required further study. However, sufficient information had already been obtained to make it clear that some rationalization and planning for the future was an urgent need. The committees agreed to continue work during the coming year.

Very enjoyable visits were paid to the laboratories, packing station and experimental growing station of the Pyrethrum Board as well as to the Nakuru Bird Sanctuary, where flamingoes were seen in their thousands. The Conference ended with a dinner arranged by the Section at which a number of distinguished guests including the Mayor of Nakuru and the Chairman and Deputy Chairman of the Pyrethrum Board were entertained.

The three lectures were given by Dr A. A. Goldberg who spoke on 'The Pyrethrum Industry,' by Dr J. B. D. Robinson on 'Nitrogen and the Coffee Tree,' and by Dr R. F. Naylor on 'Applications of Radioactive Isotopes.'

It is hoped that it will be possible to print Dr Goldberg's lecture in full at a later date.

Nitrogen and the Coffee Tree. Dr Robinson began his lecture by showing that field experiments carried out on the Coffee Research Station, Ruiru, had demonstrated substantial and economic increases of *Coffea arabica* with nitrogen fertilizers in general, and outlining the problems that had arisen whilst trying to interpret the variation of yield in relation to organic mulch and different types of nitrogen fertilizer treatments. The main parts requiring elucidation were (*a*) the greater efficiency of nitrate as opposed to ammonium-type fertilizers in the absence of mulch, (*b*) the negative interaction recorded in wet years between mulch and ammonium-type fertilizers, although generally the effects of those two treatments have been additive under the climatic conditions present in the larger part of the Kenya coffee-growing area, and (*c*) the lack of response to nitrate fertilizer in the presence of a mulch; the general influence of mulches and different nitrogen fertilizer types, alone and in all combinations, on the level of soil nitrate and ammonia in relation to rainfall, soil moisture, coffee growth and crop production.

A study of natural nitrate and ammonium trends in the top 2 ft of soil profile over a period of 14 months has shown: that soil nitrate levels fall quickly and markedly with the onset of the main rains, a period when the maximum growth surge takes place; that the level of available nitrate is reduced in this manner by leaching through the soil as well as following uptake by the coffee tree; that nitrate accumulates during the dry periods between the rains; that when soil moisture levels do not reach field capacity for any length of time and rainfall is not heavy and intense, *i.e.* during the small rains period, soil nitrate levels are high in the absence of leaching.

A second trial in the form of a 3×3 factorial layout compared, in terms of nitrate and ammonium nitrogen levels in the top foot of soil profile, nitrate and ammonium-type fertilizers in the presence and absence of both an organic and an inert (stone) mulch. It was found after 20 months that the presence of a mulch *per se* led to lower soil-nitrate values but did not influence soil-ammonia levels appreciably in comparison with the unmulched control treatment; that this effect was offset with an organic mulch by the addition of organic matter, nitrogen and minerals following slow decomposition, and by increased insect and microbiological activity; that, in the absence of a mulch, sodium nitrate raised the level of the soil more effectively than ammonium sulphate or urea (in the presence of a mulch, however, it was not so effective in this respect); and that in the presence of mulch the fertilizers were not efficient in raising soil-nitrate levels. In particular the inefficiency of urea fertilizer could be attributed to substantial leaching through the top soil before being changed to an ammonium form, which is subject to ready and rapid adsorption by the soil exchange complex.

It was concluded from these soil studies: that in terms of crop increase sodium nitrate was more effective than ammonium sulphate in the absence of an organic mulch, because of the higher soil nitrate levels following application; that in the presence of a partial mulch cover in coffee, confining the application of nitrogen fertilizer to the unmulched soil surface around the tree rather than to the mulched soil surface, would be more effective in terms of crop yield; that urea might not be as efficient a form of fertilizer as ammonium types when applied in the presence of mulch; and that it seemed probable that ammonium-type fertilizers and urea, when applied to mulched coffee would be more efficient if applied as applications during the main rains period. This would maintain a higher nitrate level in the top soil throughout the period or for a greater part of it, for carrying over into the dry weather following the rains, at which time the bulk of the coffee crop is being matured on the tree.

Finally Dr Robinson gave yield results from field trials covering the last three points noted.

Applications of Radioactive Isotopes. Dr Naylor first gave a brief account of the structure of the atom and of the changes associated with radioactive disintegration. Early studies with radioactive materials as tracers were necessarily confined to the few naturally-occurring radioactive elements, but the field was considerably extended with the discovery of artificial radioactivity. However, it was not until the production of radioisotopes in the atomic pile greatly increased the availability of suitable materials, that tracer research became really widespread. Principles governing the choice and use of an isotope as a tracer were outlined and methods of detection discussed. Examples of application were then quoted from the fields of chemical analysis, engineering, agriculture, biochemistry, archaeology and medicine.

Included in the medical studies was that at present being carried out at Makerere College on anti-leprosy drugs. Here the use of ^{35}S-labelled drugs enabled very small changes in the concentration of the drug to be detected and the actual uptake by the bacteria to be measured. A study of protein synthesis from ^{14}C-labelled amino acids offered great possibilities, particularly in determining the effect of added drugs on the rate of synthesis. This work is still in an early stage but Dr Naylor hoped to be able to report more at future conferences.

Election of Officers and Members of Committee. The following Officers and Members of Committee were elected:—Chairman, Mr W. H. Dyson; Hon. Secretary, Dr R. F. Naylor; Hon. Treasurer, Mr C. D. Allen; Members of Committee, Messrs R. M. Brachi, N. Kirby and E. V. R. Khomo. Dr M. Woodhead was elected Hon. Auditor.

EASTERN INDIA

The Analysis of Curd. A joint meeting with the Institution of Chemists (India) was held on 5 August, 1959, in the lecture theatre of the School of Tropical Medicine, Calcutta, with Dr U. P. Basu in the Chair. Mr S. N. Mitra, Director, Central Food Laboratory (Calcutta), gave a lecture on 'Implications in the Analysis of Curd (*Dahi*).'

After describing the general procedure for preparing the soured and sweetened curd by lactic fermentation of warm milk, Mr Mitra mentioned the various difficulties involved in the determination of fat and S.N.F. contents of curd by the usual methods employed for milk. He further pointed out that satisfactory results on the fat content could be obtained by application of the Werner–Schmidt method to the soured curd and the Rose–Gottlieb procedure to the sweetened material. The Geber process seemed to be quite unsuitable for the purpose owing to the semi-solid consistency of the product. For the extraction of fat, a modified Werner–Schmidt tube was also described, which was claimed to have several advantages over the conventional Rohring tube. Mr Mitra finally dealt with the complications in the determination of S.N.F. in curd, particularly because of the possibility of the presence of volatile substances, mainly acetic acid, and suggested an accurate method based on neutralization of the product with a known amount of alkali, before evaporation. Estimation of S.N.F. in sweetened curd, however, involved a separate estimation for the associated cane sugar.

Dr R. N. Chakravarti expressed the thanks of the Section to Mr S. N. Mitra and Dr U. P. Basu.

The Chemistry of Cerebrosides. On 19 December, 1959, in the applied chemistry lecture theatre of the University College of Science and Technology, Calcutta, Dr B. N. Ghosh gave a talk on 'The Chemistry of Cerebrosides.' Dr K. N. Bagchi, Vice-Chairman, presided.

The lecturer gave a short résumé of the chemical methods of isolating cerebrosides from brain tissues and discussed the structural formulae of some of those which were more or less well established. Certain cerebrosides and cerebroside-like substances which have been isolated from the stroma of erythrocytes of mammals, are designated as 'erythroses'. The chemical composition of erythroses differs from species to species, and the immunological specificity of the substances depends on their actual chemical nature. The cerebrosides and allied substances accumulate in the brain and spleen of patients suffering from Tay–Sachs idiocy, Niemann–Pick's diseases and Gaucher's diseases. Dr Ghosh finally suggested that it would be worth while to investigate whether the cerebrosides *in vivo* can take part in antigenic reactions and whether such reactions could be used in detecting the specific diseases.

The vote of thanks was proposed by the Chairman.

News and Notes

MEETINGS AND EXHIBITIONS

British Computer Society.—The 2nd Annual National Conference of the Society will take place in Harrogate from 4 to 7 July. The fee for the Conference will be 30*s.* for members of the Society and £5 for non-members. Further details and application forms may be obtained from Miss D. E. Pilling, The Electronic Computing Laboratory, The University, Leeds 2.

Chemical Society Symposium.—The Chemical Society is arranging a symposium on Physical, Chemical and Biological Methods in the Study of High-Molecular-Weight Carbohydrates to be held in the Edinburgh and East of Scotland College of Agriculture from 12 to 14 July. An informal dinner will take place on the evening of 13 July. A registration fee of 35*s.* will be charged to non-Fellows of the Society but Fellows may attend the scientific sessions free of charge. Accommodation can be arranged if application is made before 1 June. All enquiries should be addressed to the General Secretary, Chemical Society, Burlington House, London, W.1.

International Congress of Industrial Chemistry.—The 32nd International Congress of Industrial Chemistry will take place in Barcelona from 23 to 30 October. Further details may be obtained from Camara Oficial de la Industria, Ancha, 11, Barcelona 2, Spain.

Laboratory Apparatus and Materials.—An exhibition, organized under the sponsorship of the journal *Laboratory Practice*, will be staged in the Royal Horticultural Society's New Hall at Westminster on 20–23 June. A series of 12 lectures on recent advances in laboratory techniques has been arranged to take place during the exhibition, and further particulars may be obtained from U.T.P. Exhibitions Ltd, 9 Gough Square, Fleet Street, London, E.C.4.

Polarographic Society.—A meeting, under the title Automatic Analysis by Electrochemical Methods, will be held at the Royal College of Science, London, on 25 May at 7 p.m. Three papers will be presented on Automation of titrimetry, colorimetry and polarography in process monitoring instruments, by D. R. Chapman; Recent developments in the uses of continuous conductivity measurements, by P. H. Crumley; and the Auto-analyzer system of continuous wet chemical analysis, by Dr A. L. J. Buckle.

Further details are obtainable from Mrs B. Lamb, 42 Blenheim Gardens, Wembley, Middx.

Pure Food Centenary—Further details are now available of the Conference being arranged to celebrate the Pure Food Centenary (*J.*, 1959, 663) which will take

place in London on 20 to 23 September. Papers will be presented on The 1860 Act and its influence on the purity of the world's food: historical introduction, by J. H. Hamence; Pure food for the people: the manufacturers' contribution, by Dr E. B. Hughes; Pure food and the Commonwealth, by Dr J. G. Malloch; International aspects of pure food and pure food legislation; by Dr N. C. Wright; National problems, by Dr C. A. Morrell (Canada), Professor F. H. Reuter (Australia), and Dr G. P. Larrick (U.S.); and The integration of food research, by Professor A. C. Frazer.

All interested are asked to write to the Secretariat, The Pure Food Centenary, 14 Belgrave Square, London, S.W.1.

Research Methods and Instrumentation.—A preliminary announcement of a symposium on Recent Developments in Research Methods and Instrumentation to be held in conjunction with an exhibition at the National Institutes of Health, Bethesda, from 4 to 10 October has been issued. Topics for discussion will include fluorescence, infra-red, activation analysis, the ultracentrifuge, microscopy and electrodes.

Further particulars may be obtained from the Executive Secretary, National Institutes of Health, Bethesda 14, Maryland, U.S.A.

Exhibition of Scientific Instruments.—At Birkenhead Technical College on 16 and 17 June an exhibition of scientific instruments of interest to the chemical and allied industries will take place. The exhibition has been arranged by Quickfit & Quartz Ltd.

OCCA Technical Exhibition.—The 12th Exhibition, which took place on 15–17 March, was the most successful held so far. The standard of the exhibits was high, as shown in the examples below, and more than 7,000 people attended, including representatives from 22 oversea countries.

Twenty-one schools sent parties of sixth-form science students, and short talks were given to them on the paint and printing ink industries. An entire stand was

devoted to technical education, manned by representatives from four technical colleges in the London area.

The photographs show the Information Centre and one of the Exhibition stands.

EDUCATIONAL

Institution of Chemical Engineers.—The Regulations for admission to Graduate and Associate Membership of the Institution have recently been revised in part. The revisions are concerned mainly with the definition of qualifications which exempt completely or partially from the Institution's examination. The new basis for complete exemption from the Institution's examination is the satisfactory completion of an honours degree course for a first degree in chemical engineering of a British University. Many students who were previously required to take Part 3 (The Design Problem) or Part 4 (The Oral Examination) for election to Associate Membership are exempted from the whole examination. They will, of course, have to comply with the other requirements for such election.

Nuclear Technology.—A further postgraduate course in nuclear technology (chemical) has been arranged by the Department of Chemical Engineering and Chemical Technology at the Imperial College of Science and Technology for 1960-61. Satisfactory completion of the course will qualify students for the award of the Diploma of Imperial College.

The course is intended for graduates in chemical engineering, chemistry and metallurgy and is also available to other suitably qualified applicants from industry. It is full-time for one year.

The fee for the course is £64.

Applications for admission should be made as soon as possible, and in any case not later than 1 June on a form

obtainable from the Registrar, Imperial College, London, S.W.7.

New Careers Booklets.—The Central Youth Employment Executive has recently issued No. 100 in its *Choice of Careers* Series. This issue is entitled 'The Scientist' and is written mainly for those science students who aim at obtaining a degree or equivalent qualification by means of a university or technical college course. No attempt is made to cover every branch of science but most attention is given to chemistry, physics and biology, since the great majority of scientists begin their careers with one or more of these basic sciences. Reference is also made to mathematics, geology and metallurgy. In addition to explaining the qualifications and training of scientists, the booklet describes the main kinds of work that science offers and gives a guide to the industrial organizations and government departments that employ scientists.

Issued in the series at the same time is booklet No. 94 entitled 'Laboratory Technicians and Assistants.' This booklet describes, by examples, the types of work a laboratory technician or assistant does and the qualities and qualifications required for such work.

The Central Youth Employment Executive has also re-issued No. 1—'Choosing Your Career,' which aims to give general help to boys and girls, and their parents, in the choice of a career.

Copies of each of these booklets may be obtained from H.M.S.O.: No. 100, 1*s.* 3*d.*; No. 94, 2*s.* 6*d.*; No. 1, 1*s.* 6*d.*

Science in Secondary Schools.—The Ministry of Education has issued a new pamphlet (No. 38) entitled *Science in Secondary Schools*, written by a group of Her Majesty's Inspectors whose aim is to help and stimulate the better teaching of science in schools.

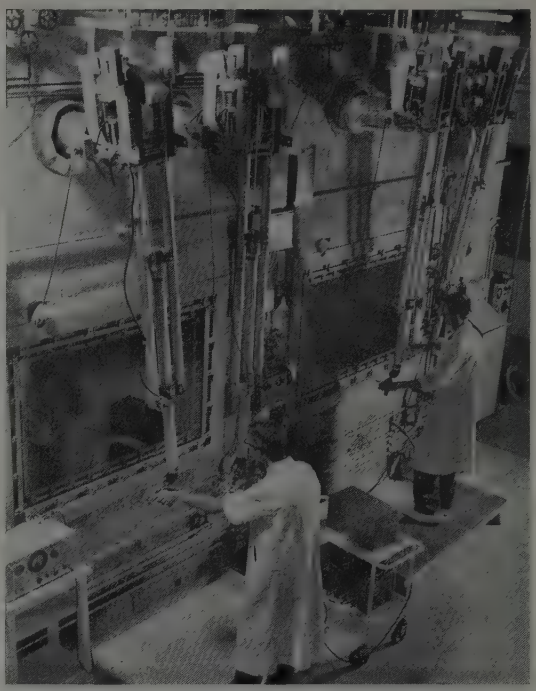
The objects of this publication are to survey the teaching of science in our schools, to analyse the purposes which should inspire it and to suggest practical measures for carrying these out. The largest section of the book is devoted to a consideration of courses of study for pupils over the age of 15 years, with due reference to courses in science for the non-scientist. This is preceded by a section on courses for 11 to 15 year-olds. The book also contains some practical considerations of the design of laboratories and the making of apparatus in schools.

Copies may be obtained from H.M.S.O., or through any bookseller, price 6*s.*

NEW AND RECENT PUBLICATIONS

Fuel Abstracts.—The Institute of Fuel is publishing from mid-May a monthly summary of world literature on all technical and scientific aspects of all fuel usage to be entitled *Fuel Abstracts and Current Titles*. The subscription price is 12 guineas per annum, 25*s.* per copy. Further details are available from the Institute of Fuel, 18 Devonshire Street, Portland Place, London, W.1.

Radioactive Chemicals and Sources.—An indication of the rapid expansion in the provision of primary isotopes, labelled compounds and β- and γ-sources is given by the fact that the Radiochemical Centre now issues its Catalogue in two parts—*Radioactive Chemicals* and *Radioactive Sources*. The first of these deals with materials of interest to all employing radioactive tracer methods and who use radioactive pharmaceuticals. It also includes radioactive reference sources for calibrating instruments. The second catalogue deals with sealed radioactive sources and appliances and will interest radiotherapists and industrial users of ionizing radiations. It also includes a great variety of radioactive sources which can be used for research purposes. Copies of the catalogues can be obtained from the Radiochemical Centre, Amersham, Bucks.



Hot Caves for handling kilocurie quantities of mixed fission products

A new 24-page booklet describes the growth of the Centre from its beginnings in 1940 to its present status as a scientific and commercial establishment known throughout the world. Copies can be obtained from H.M.S.O. or through any bookseller, price 5*s.*

Earthquake-Proof Reactor for Japan.—Japan's first Nuclear Power Station, to be built at Tokai-Mura, 70 miles north-east of Tokyo, was fully described in *Nuclear Power* for March. Designed by the General Electric Company and Simon-Carves Ltd it follows the same general pattern set by the Calder Hall Station. The whole station is designed to resist earthquake shocks. The British General Electric Co. of Japan has been formed to handle the contract work there. A coloured sectional drawing, approximately 3 ft × 2 ft, was published at the same time, and copies are available at 2*s.* 6*d.*, post free, from Rowse-Muir Publications Ltd, 77-79 Charlotte Street, London, W.1.

Flammable Liquid Risks.—A leaflet outlining the precautions necessary to reduce the risk of accidents arising from the use of flammable liquids has been circulated to factory owners and occupiers by the chief inspector of factories, Mr T. W. McCullough. The leaflet advises all users of flammable liquids to familiarize themselves with the properties of these liquids and the risks attached to them. It is suggested that a responsible person in each factory should be put in charge of the arrangements for fire precautions. Various methods of accident prevention are suggested and warnings about the design of protective clothing are given.

Nuclear Science in Pakistan.—Plans for the establishment of a National Institute of Nuclear Sciences and Technology near Rawalpindi are now progressing. The Institute will have a research reactor and supporting laboratories with facilities for training and research. Research will be confined to the peaceful applications of atomic radiations and will include the development and design of power reactors for future installation as a supplementary source of electric energy.

The Pakistan Atomic Energy Commission is also planning research on the peaceful uses of atomic energy in agriculture, medicine and industry. Two centres, one at Lahore and another at Dacca, are contemplated.

U.K. Oil Consumption.—Oil consumption in the United Kingdom rose in 1959 by 17·3 per cent to reach a total of 36½ m. tons, according to figures issued by the Petroleum Information Bureau.

The greatest increase was again in fuel oil consumption (including that for public electricity generation), being nearly a third higher than for the previous year and reaching nearly 14 m. tons. The oil refineries also consumed further quantities of fuel oil. Although deliveries of gas/diesel oil increased by 4·6 per cent the use of this product in gasworks is declining, since it is being replaced by distillate feedstock and petroleum gases.

During the year more than 7 m. tons of motor spirit were consumed, 7·5 per cent more than in 1958. Consumption of motor spirit by commercial users fell by 3 per cent owing to the growing preference for diesel-engined vehicles.

Obituary

Oliver Chick. *B.* 24.7.1885. *Ed.* City and Guilds of London Institute, under Professor R. Meldola, 1900–03. He entered the laboratory of Dr E. R. Moritz, Public Analyst, in 1904, and two years later took a post with Howard & Sons Ltd as assistant chemist in the private laboratory of David Howard. He remained with the firm for the whole of his working life until his retirement in 1949, when he was a works chemist specializing in quinine and fine chemicals. He was the author, or co-author, of a number of scientific contributions. 'He was always the most charming colleague to work with; he had no enemies and was beloved and respected by all who had the privilege of working with him.' (*A.* 1919, *F.* 1927.) *D.* 2.1.60.

Milton Dewhurst. *B.* 14.12.1898. *Ed.* Blackburn Technical College, 1916–17; Trinity College, Dublin, 1919; University of Manchester, 1919–21. B.Sc. (Manc.). He served with H.M. Forces, 1917–19, returning to his studies on his release. He was appointed chemist to the Birmingham Chemical Co. Ltd in 1922. He left the following year to become chief chemist to White, Tomkins & Courage Ltd, Reigate, and was promoted to general manager and chief chemist in 1924. He was made a director in 1945 and remained with the company until his retirement in 1957. From 1940 he acted also as consulting chemist to Thomas & Evans Ltd, Porth. (*A.* 1921, *F.* 1943.) *D.* 22.12.59.

William Alexander Falconer. *B.* 12.6.1900. *Ed.* Robert Gordon's College, Aberdeen; Royal Technical College, Glasgow, 1919–22. B.Sc. He was appointed a chemist at the Calico Printers' Association Ltd in 1923, where he remained until 1929, when he joined Arthur Coles Ltd as a chemist and works manager. He became a civilian inspector at the Ministry of Supply in 1940, and took an appointment as chief chemist and technical manager in the textile division of R.F.D. Ltd in 1945. Four years later he was appointed works manager at Treforest Silk Printers Ltd, where he remained for the rest of his life. (*A.* 1923, *F.* 1950.) *D.* 23.1.60.

William Robert Fearon. *B.* 14.10.1892. *Ed.* St Andrews College, Dublin; Trinity College, Dublin, Sir Patrick Dun's Hospital, Dublin, 1912–17; University of Cambridge, 1917–20. M.A., M.B., Sc.D. (Dubl.), B.A. (Cantab.). Work for the Ministry of Food during the First World War confirmed the reputation for unusual brilliancy he had won at both universities. He undertook research work for the Food Investigation Board, Department of Scientific and Industrial Research, at Cambridge in 1918, and the following year won an Exhibition to Emmanuel College, Cambridge, where he spent two years. He returned to Trinity College, Dublin, in 1921, and was elected a Fellow of the College the same year. The chair of biochemistry was created

for him in 1934. His gifts as a scientist and humanist were manifested in a wide range of activities, and yet with a certain diffusion which robbed him of the fullest achievement. Style, precision and wit were an essential part of his writings and lectures, and indeed of all that he did. A lightness of touch never left him, manifesting itself in verse and stories and even in sketches for a music-hall comedian with whom he had formed a friendship. Many papers and other publications appeared on biochemistry and more general subjects including *An Introduction to Biochemistry* (1934). He had been a university member of the Irish Senate since 1943. He was a lover of music, a fine pianist himself, a deft craftsman in the field of light verse, a theatre lover and a playwright. 'His wit and felicity of phrase made Fearon a charming companion, and he was sociable and courtly by nature.' (*A.* 1917, *F.* 1921; Council 1924–27, 1930–33.) *D.* 27.12.59.

Joan Mary Lancaster. *B.* 11.7.11. *Ed.* Harrow County School for Girls; Royal Holloway College (University of London), 1930–33. B.Sc. She became a research worker at the London School of Hygiene and Tropical Medicine in 1934. She left in 1939 to join the Ministry of Supply as an experimental assistant in the Chemical Inspection Department. She was appointed hospital biochemist and biochemical assistant to the pathologist at the Royal Sussex County Hospital, Brighton, in 1943, a post which she held until shortly after her marriage in 1954. (*A.* 1950.) *D.* 3.1.60.

Mathew Morton. *B.* 13.4.1891. *Ed.* Paisley Grammar School; University of Glasgow, 1909–13. B.Sc. He was appointed a teacher of mathematics and science under the Glasgow School Board in 1913 and the following year undertook similar duties under the Govan School Board. He became a works chemist in H.M. Factory, Oldbury, in 1917. He returned to teaching in 1919 in secondary schools at Glasgow and became head of the science department of Govan Senior Secondary School in 1940. He was appointed headmaster of Adelphi Street Junior Secondary School, Glasgow, in 1947, a position which he held until his retirement in 1957. During the Second World War he served on the Science Panel set up by the Scottish Education Department for examining school-leaving-certificate candidates. He was also a former president of the Western District Science Section of the Educational Institute of Scotland. (*A.* 1919, *F.* 1947.) *D.* 7.11.59.

Owen Owen. *B.* 22.8.1896. *Ed.* Friars School, Bangor; University College, Bangor, 1915, 1918–1921. B.Sc. (Wales). He worked in H.M. Factories from 1916 until 1918, when he returned to his studies. He continued at University College, Bangor, as a part-time lecturer and demonstrator until 1922, when he was appointed chemist and later chief chemist at the Experimental and Research Station of the Nursery and Market Garden Industries' Development Society Ltd, Cheshunt. In 1927 he was awarded the degrees of M.Sc.(Wales) and Ph.D.(Lond.). He became scientific adviser to Pollards Nurseries Ltd, Cheshunt, in 1952, and a few years later took a similar post at E. G. Fouracres & Sons Ltd, Cheshunt, where he remained until his retirement in 1959. He was the author of scientific papers. (*A.* 1921, *F.* 1944.) *D.* 8.1.60.

William George Painton. *B.* 25.10.1899. *Ed.* Owen's School, Islington; Chelsea Polytechnic, London, 1919-22. B.Sc. During the First World War, he served in the R.N.A.S., 1917-19. On completion of his studies, he joined George King & Co. Ltd as a chemist, later becoming technical manager and chief chemist. He remained with the same firm for the whole of his working life. (*A.* 1923.) *D.* 20.5.59.

Albert Cecil Pepper. *B.* 24.2.14. *Ed.* Loughborough College, 1931–36; Chelsea Polytechnic, 1937–1945. B.Sc., Ph.D.(Lond.). He joined Alexander Duckham & Co. Ltd as a chemist in 1936, where his exceptional ability gained rapid promotion for him. He became chief chemist in 1941, a director in 1943, joint managing director in 1952 and managing director in 1959, a position which he held at the time of his death. 'He endeared himself to a wide circle of friends and to all who worked with him by an inherent personal charm, his sincerity and sympathetic interest for the many who sought his help and advice.' (*A.* 1938, *F.* 1945.) *D.* 21.12.59.

Bertram Pusey Ridge. *B.* 15.2.1893. *Ed.* Technical College, Stafford; King's College, London, 1919–21. B.Sc. He served with H.M. Forces during the First World War. After completing his studies, he joined the staff of the British Cotton Industry Research Association in 1921. He was awarded the degree of Ph.D.(Lond.) in 1926. Six years later he was appointed a research chemist at Imperial Chemical Industries Ltd in what is now the General Chemicals Division. In 1946 he was transferred to the Plastics Division, and a few years later joined the Terylene Council. On his retirement in 1955, he set up a consulting practice in textile chemistry. (*A.* 1921, *F.* 1926; Council 1930–33.) *D.* 9.1.60.

Alexander Rule. *B.* 15.8.1880. *Ed.* Merchant Taylors' School, Great Crosby; University College (now the University), Liverpool, 1897–1902; University of Jena, 1902–4. M.Sc.(Manc.), Ph.D.(Jena). He was appointed lecturer in chemistry at the University of Liverpool in 1905 and became also an adviser to the All-India Association. He was awarded the degree of D.Sc. by the University of Liverpool in 1914. The following year he joined the Ministry of Munitions, where his wartime work was recognized by the award of the M.B.E. Shortly after the termination of the war,

he took an appointment at British Celanese Ltd until 1924, when he became the resident representative in Germany of the British Bergius Syndicate, working at the experimental station at Mannheim-Rheinau. He returned to this country in 1927 to join Imperial Chemical Industries Ltd at Billingham as manager of the Oil Division Research. In 1931 he was appointed assistant research manager and later the same year laboratories controller and administrator, positions that he held until his retirement in 1944. He contributed a number of papers to the *J. chem. Soc.* As a young man Dr Rule was a well-known climber and pot-holer. For many years he was an active member of the Yorkshire Ramblers Club. (*F.* 1919.) *D.* 12.1.60.

George Herbert Spilman. *B.* 22.11.1888. *Ed.* Hull Technical College, 1902–10. He entered Reckitt & Sons Ltd, Hull, as a chemist in 1906. He was transferred in 1914 to one of the firms subsidiaries in London, where he was chemist in charge of production. During the First World War he joined Nobel's Explosives Co. Ltd at Ardeer and after helping to start up several plants in different parts of the country, was eventually posted to the Air Ministry in London. In 1916 Henry and Camille Dreyfus came to this country to supervise a large factory at Spondon to manufacture aircraft 'dope' from cellulose acetate. This factory came under the direction and control of the section of the Air Ministry to which Spilman had been appointed. After the war Henry Dreyfus turned to the development of acetate rayon yarns and fabrics, and in 1919 Spilman joined the firm, later to become known as British Celanese Ltd, as sales manager. He remained with them for the rest of his life, becoming a director in 1927, managing director in 1945, and chairman in 1957. (*A.* 1918, *F.* 1943.) *D.* 22.12.59.

Walter Edward Stein. *B.* 20.4.02. *Ed.* University Technical College, Prague, 1921–25; University of Berlin, 1926–27; Institute of Physiological Chemistry, University of Prague, 1927–29; University College, London, 1940–41. D.Sc.(Prague). He occupied a number of posts in Germany before coming to this country in 1941, when for a few months he was an assistant works manager, Royal Ordnance Factories. He left England the following year to take a similar post in the Indian Ordnance Factories, became assistant civil engineer adviser, Department of Supply, India, in 1945, and chief rehabilitation officer, Department of Labour, India, in 1946. He returned to England in 1947 and was employed for two years as a member of a team engaged on the compilation of technical and scientific information for an organization set up by the Association of British Chemical Manufacturers. He took up teaching in 1950 and at the time of his death was senior lecturer in chemical engineering, West Ham College of Technology. (*A.* 1947, *F.* 1950.) *D.* September, 1959.

CORRESPONDENCE

Preparation for Science

Sir,—The problems of school examinations and of University entrance requirements are so widely discussed that one hesitates to poke again at this smouldering bonfire of controversy. Nevertheless, having seen the workings of the G.C.E. in relation to University selection in England, it has been of interest to examine the rather simpler problems of matriculation in Australia, where the wider objectives of the G.C.E. press less heavily on the examiners.

The particular point which emerges very clearly—and it is of equal force on both sides of the world—is the effect of the confusion between the underlying understanding of scientific subjects and the mere possession of information. It is clear that, before a person can benefit from University training, he must possess certain basic knowledge: in its lowest terms, the ability to read, to write and to perform certain arithmetical operations. It is also necessary that he should be familiar with some basic scientific concepts like those of force, mass, refractive index, the distinction between elements and compounds, and the working of Le Chatelier's principle.

These things are the ABC of science, and it is easy to test a candidate's familiarity with them by an examination; but while they are being taught the student has the opportunity of acquiring the habits-of-mind of a scientist, the beginnings of an appreciation of exact expression and of the place of observation and experiment. This is the real test of the teacher and the real foundation of future study. Unfortunately these latter things are much harder to test and are too often overlooked altogether. There is a tendency to go on adding to the 'information' without real regard for what it brings with it. Too often also the use of topical matters to secure the attention of pupils is allowed to run riot. Thus, in a recent matriculation physics paper was set a question: 'How many of each of the following particles are there in the most common kind of helium atom: electrons, neutrons, protons? Show in a diagram how they are arranged to form the atom.' Now, it is probable that the examiner felt he was giving encouragement to the boy who read his textbooks: but in fact the effect has been to cause science teachers over a wide area to teach 'atomic structure' on a large scale to their pupils. And all of this has to be taught with the barest hint as to the reasons why scientists have been led to these beliefs. It has been hailed with delight by some teachers who can introduce 'topical' matter into their teaching in this 'atomic' age. Others merely register disgust at the introduction of still more material into an already overloaded syllabus. But already in a very short time it has led to the development of an authoritarian attitude towards scientific information—'the scientists say so;

far be it from me to question their edict'—which is of the greatest potential danger to our scientist of the future.

Surely the fundamental point must always be kept in mind that all our theories and models, however elaborate, are always put forward to account for observable phenomena; and that it is the duty of every scientifically-minded person to be ready to assess how far the theory goes in every case. While, therefore, it is not out of place for students to know the currents of modern scientific thought, we should not allow these to flow into our basic curriculum on a par with the fundamental concepts which lie at the back of every operation—physical and intellectual—performed by a science student; and, so far as we can, we should never introduce any new theory or hypothesis without at least some evidence or logical reason for it.

Dept. of Chemistry, G. H. CHEESMAN
University of Tasmania

NEW GRADE OF MEMBERSHIP

SIR,—Irrespective of the desirability, or otherwise, of the establishment of a new grade of membership of the Institute, the statement by the Council (*J.*, 122) contains the implication that a 'pass' degree in Science of a British University represents a higher standard of *chemical* education than a Higher National Certificate in Chemistry. There are many representatives of both industry and education in this district who would not only reject this implication but would, in some cases, actually reverse it.

This injustice is aggravated in the Appendix where Examples of Qualifications that might be acceptable as satisfying the academic requirements for admission to Licentiateship are set out. Acceptance of these conditions in their present form would mean that the possessor of a H.N.C. in Chemistry—a successful candidate of an externally assessed examination and a person with a high level of practical ability—would have to pass a second 'externally assessed examination in an approved field following the satisfactory completion of a post-H.N.C. course extending over one or two years of part-time study.'

Certainly the Institute would be wise to concern itself with looking after the interests of those (*i.e.* the great majority) who get beyond the Higher National Certificate and Diploma standard, but who do not reach Graduate Membership, for there is increasing evidence of the impending formation of an alternative qualifying body to cater especially for this class. Besides the loss of a potential revenue from this source, the Institute would surely suffer in other ways from the competition and distractions of a body it had helped to create through its own folly.

16 Renishaw Avenue, D. SHIREBY
Broom, Rotherham

[An important point here is the difference in *general* educational requirements for the H.N.C. and for a university degree.—ED.]

LABORATORY RISKS AND SAFEGUARDS

METHYLSILOXANES AND CHROMIC ACID

It has been reported[1] that chromic acid esters of methylsiloxanes are formed when methylsiloxanes are heated with chromic acid. The authors also report that local overheating during the distillation of trimethylsilylchromate can lead to explosion.

A recent experiment in our laboratory involved the mixing of a methylpolysiloxane (56 g, *M* 3,000) and chromic acid (74 g). The mixture was heated from 25°C to 140°C over a period of 60 minutes. After a further 20 minutes at this temperature, a violent explosion occurred, causing severe damage to the fume cupboard in which the experiment was being conducted and to equipment in the vicinity of the experiment.

It would appear that explosive reaction can occur below distillation temperatures of chromic acid esters.

Because of the extensive use of chromic acid for cleaning purposes, the need for extreme care in the use of hot chromic acid as a cleaning agent for apparatus which contains oxidizable residues is again emphasized.

F. C. SAUNDERS,
Midland Silicones Limited, Product Development
Barry, Glamorgan Group

[1] Schmidt and Schmidbaur, *Angew. Chem.*, 1958, 704.

THE REGISTER

DEATHS

Fellows

(P) ARNAUD, Francis William Frederick. Died 15 March, 1960, aged 81. *A.* 1902, *F.* 1905

(H) ARUNDEL, Edgar, B.SC. (LOND.). Died 28 March, 1960, aged 65. *A.* 1915, *F.* 1922

(V) AYLING, Ernest Edward, M.SC. (LOND.). Died 30 March, 1960, aged 59. *A.* 1921, *F.* 1931

(C) BROOKES, Alfred, M.B.E. Died 9 April, 1960, aged 55. *F.* 1956

(D) HEAVEN, George Samuel, B.SC. (LOND.). Died 13 April, 1960, aged 82. *A.* 1914, *F.* 1917

(P) JONES, Frederick Elston, D.SC. (WALES). Died 5 April, 1960, aged 56. *A.* 1926, *F.* 1946

(P) MACKENZIE, William Donald. Died 7 April, 1960, aged 67. *A.* 1930, *F.* 1933

(A) MACMILLAN, Alexander Forbes. Died 14 March, 1960, aged 67. *A.* 1931

(P) PENNEY, Alfred Charles, M.SC. (LOND.). Died 18 April, 1960, aged 56. *A.* 1932, *F.* 1944

(W) PULLMAN, Arthur Donald Rieber, B.SC. (MANC.). Died 21 April, 1960, aged 72. *A.* 1917, *F.* 1925

(P) ROBSON, Stanley, M.SC. (DUNELM.). Died 26 March, 1960, aged 71. *A.* 1918, *F.* 1944

(P) SAGEMAN, Philip John. Died 1 April, 1960, aged 83. *F.* 1916

(M) SMITH, Lionel Hewgill. Died 27 March, 1960, aged 68. *A.* 1927, *F.* 1930

(C) THOMAS, Garfield, M.SC. (MANC.). Died 24 March, 1960, aged 63. *A.* 1921, *F.* 1940

Associates

(P) BULL, Philip Cecil, D.S.O., T.D. Died 23 March, 1960, aged 71. *A.* 1917

(R) PAINTER, George Macaulay, O.B.E., M.C., B.SC. (LOND.). Died 8 April, 1960, aged 74. *A.* 1917

(B) STILL, Charles James, B.SC. (LOND.), M.SC., PH.D. (Q.U.B.). Died 6 April, 1960, aged 80. *A.* 1918